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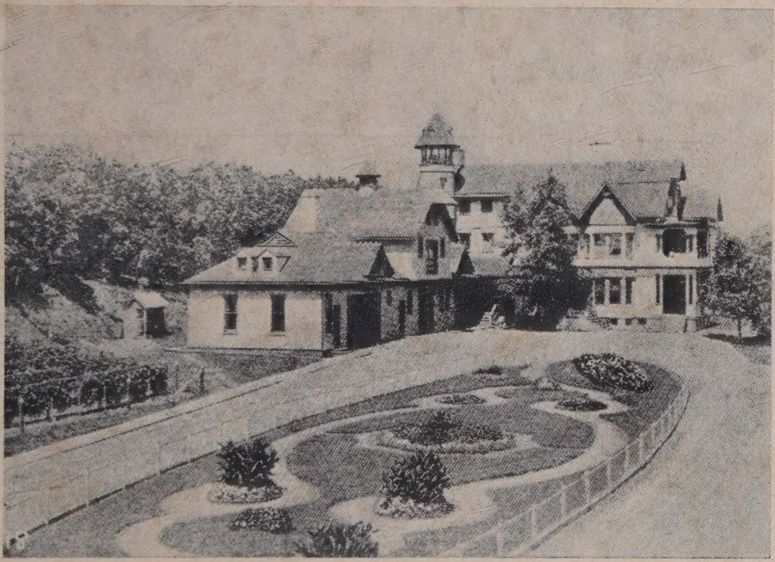
Agricultural Research Through Fifty Years

1885-1935



FIRST ADMINISTRATIVE HEADQUARTERS OF THE MINNESOTA AGRICULTURAL EXPERIMENT STATION

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

This bulletin records the program presented at the semi-centennial celebration of the founding of the Minnesota Agricultural Experiment Station which was held at University Farm, St. Paul, June 14 and 15, 1935. This celebration was also the occasion for giving special recognition to the services of Dr. Andrew Boss, retiring vice-director of the station. Addresses delivered at the semi-centennial appear in full in these pages.

Agricultural Research Through Fifty Years

1885-1935

Edward D. Porter

Professor of Agriculture, University of Minnesota, 1881-1889, and first Director of Minnesota Agricultural Experiment Station, 1885-1889.

OPENING SESSION

Friday Afternoon, June 14, 1935

Theme: The Historical Background of The Minnesota Agricultural Experiment Station

Presiding: E. M. Freeman, Dean, College of Agriculture, Forestry, and Home Economics

ADDRESSES

1. Historical Outline of the Organization and Development of the Minnesota Agricultural Experiment Station, Andrew Boss, Vice Director.

2. The Need for Agricultural Research Fifty Years Ago, Eugene Davenport, Former Dean and Director, Illinois Agricultural College and Experiment Station.

3. The Need for Experiment Stations Then, H. H. Shepperd, President, North Dakota Agricultural College.

4. The Need for Experiment Stations Now, W. C. Coffey, Dean and Director, University Department of Agriculture.

HISTORICAL OUTLINE OF THE MINNESOTA AGRICULTURAL EXPERIMENT STATION

Andrew Boss, Vice-Director, Minnesota Experiment Station

History is seldom recorded at the time it is made. Institutions and movements are usually built up slowly from meager beginnings and with uncertain objectives. Fortunately, however, legislative enactments are usually preserved, resolutions and official actions recorded, and sufficient data established to permit ferreting out important steps in development. Time and experience are required to bring out the significant features of an institution, or movement, to give a correct perspective of it and to evaluate its influence and services. That, at least, is the course of history covering the birth and life of the Minnesota Agricultural Experiment Station. The outline of its history, as here offered, is the result of a careful and painstaking search for the pertinent facts bearing upon its establishment. It is known to be incomplete and time will permit only a review of some of the most important events. The full history, however, with annotations and references is being prepared in full for later publication.

The demand for research in agriculture appears to have arisen out of the needs of farmers in territorial days for assistance in meeting their farming problems. These demands may be found in the records of proceedings of the territorial agricultural and horticultural societies of the then newly settled territory. The need for information and knowledge about the problems which were being met in the new environments were ever-recurring topics for discussion at the annual meetings of these societies. These were, in all probability, simply repercussions of discussions going on at the same time, or at earlier dates, in the earlier settled states along the Atlantic Sea Coast and in those lying between the Allegheny Mountains and the Mississippi River. Many of the settlers of the territory had come from these eastern states, bringing with them the problems, customs, and traditions of the east. They found in the west new problems and banded together to work out means for solving them. Among these early settlers were men of vision and advanced ideas who saw the necessity for joint action and concerted effort in bringing to the attention of the territorial and federal government their need for information and insisting on the advisability of providing institutions equipped to develop a body of knowledge bearing directly upon the agricultural industry.

The First Agricultural College and Experimental Farm Act

The efforts of Minnesota pioneers to provide for this need found expression in 1858 in the first legislative session after organization as a state. At that time one of its members, the Honorable W. S. Chowen, a pioneer farmer of Minnetonka Township, Hennepin County, introduced a bill which resulted in an act calling for the establishment of a state agricultural college. This act was approved on March 10, 1858, by Governor Sibley. It provided for an agricultural college and experimental farm at Glencoe in McLeod County. The college and farm were to be under the direction of a board of education of twelve members selected by the State Agricultural Society and renewed by the election annually, by the society, of four members.

It was not until 1860 that the Territorial Agricultural Society had legally become the State Agricultural Society. At the first meeting of the society under the new law, March 5, 1860, twelve members of the board of education for the state agricultural college were chosen. These members, with Colonel John H. Stevens as president, were re-elected the next year at the annual meeting of the society on February 4. Colonel Stevens, who had actively promoted the act and the choice of location at Glencoe, had succeeded in blending the college board with the official list of the society and in making it a coordinate part of the society. At this time 320 acres of land had been offered and accepted by the state as the college site, the deed given, and $3,500 in cash paid therefor. Donations amounting to $10,000 had been subscribed to erect the first building. It was understood that the school building should be paid for from this fund, or if it exceeded $10,000 in cost, the additional expense should be borne by the state. The effect of the financial crisis of 1857 and the depression of the following years delayed advancement of the project and prevented the erection of the building. The contract for the building had been drawn up but required Governor Ramsey's signature. His absence in Washington on civil matters prevented completion of the transaction at the time, and the intervention of the Civil War and of the Indian outbreak in the following years interfered seriously with progress on the enterprise. Colonel Stevens, the chief promoter, was himself absent in command of an army unit on a part of the frontier, resulting in still further delay. Interest did not die out entirely, however, as the society elected members to the board and maintained their organization up to 1865. In the meantime Congress had passed the first Morrill act known as the Land Grant Act, which was approved on July 2, 1862. Under this act lands were donated to the state by the federal government in support of colleges of agriculture and the mechanic arts. It is quite possible that agitation for the

donation of these land grants was responsible for, or at least hastened, the state legislation establishing the Glencoe college and experiment farm. The 1863 session of the state legislature, on January 27, accepted the donation of land for the state and authorized the commissioner of the general land office to select the land. The record shows, also, that the state legislature had previously (in 1861) made an appropriation of land known as swamp land in McLeod County, which was to be sold and the funds used in support of the college. They could be used, however, only for the erection of buildings or the endowment of professorships. Under the provisions of the Morrill Act proceeds from the sale of lands granted to the states were to be invested in a fund from which only the interest was to be used, and that only for endowment, support, and maintenance. No part of this fund could be used for buildings, and not more than 10 per cent of the amount arising from these sales could be used for the purchase of sites for experiment farms. This provision was taken advantage of later in the purchase of the first university experimental farm.

View of Experimental Farm Buildings, 1886

Soon after the passing of the Morrill Act the question had arisen as to what institutions in the state should receive the benefits accruing from the land sales. The agricultural college at Glencoe had been established legally but not actually. The territorial and state acts establishing the university had provided that it should include a department of agriculture. Friends of each institution urged the claims of their favorite for the new source of aid. The Morrill Act required that each state entitled to share in its benefits must provide an agricultural college within five years. The university at the time of the passage of the Morrill Act was in uncertain financial condition because of debts incurred during the period of over-confidence prior to the crisis of 1857. John S. Pillsbury, who in 1865 was a state senator and at the same time a member of the special board of three regents appointed to clear the university of indebtedness, with other friends of both the Glencoe

college and the University cooperated in securing the Morrill grants for Glencoe in the reorganization act of March, 1865.

The Morrill Act did not require that the support provided thereby be devoted to a single institution in each state taking advantage of it. There was a strong feeling in Minnesota, however, that the best interests of agriculture would be served by concentrating the resources in one institution. The Glencoe college had been unable to obtain any appropriations for buildings and it was apparent that it would not be able to do so, whereas the University had a building in which agriculture could be taught. The friends of the college at Glencoe and of the University were challenged at this time by the normal schools, then organizing, for a division of the funds accruing from land sales. This was indicated in the opening remarks of President Mann of the State Agricultural Society at their annual meeting in 1866. He, at that time, "reminded the delegates of a most important subject which they must consider, namely the agricultural college at Glencoe, a project long in existence and very dear to the farmers and the members of this society, which was about to be destroyed."

Colonel Stevens had by this time resumed his residence in Minneapolis and was no longer enthusiastic about the Glencoe agricultural college project. The friends and supporters of the Glencoe college, therefore, acceded to the view of the supporters of the University that the time had arrived for the consolidation of the land grants for higher education in order to make one strong institution and to avoid dissipating the land grants among the normal schools. This course had been urged in the report of the Board of Regents in 1867. In return for their support of the consolidation plan, the McLeod County people were assured of the aid of the University group in obtaining the grant of 4,684 acres of swamp land in the county, originally appropriated by the state for the agricultural college. The funds from this grant were to be used to endow a new educational institution, Stevens Seminary, to be established at Glencoe. The reorganization act for the University, under which consolidation was to be effected, was approved February 18, 1868. Approval was given for the establishment of an endowment for Stevens Seminary on March 6 the same year. It was thus that the land grant endowment was turned over to the University, and with it the obligation to establish an agricultural college, and with the college, an experimental farm.

The First University Experimental Farm

The University reorganization act of 1868 provided that the regents secure suitable land near the University for an experimental farm. Under the terms of the Morrill Act not more than ten per cent of the

proceeds of land sales could be used for such a purpose. The state auditor, who was commissioner of the state land office, had estimated that the college land grants would eventually provide a fund of over $500,000. Under authorization by the legislature, the regents authorized the purchase of land for a sum not to exceed ten per cent of the land sales as specified in the act of Congress. In anticipation of the receipts of sales, land was examined in close proximity to the college, and two tracts purchased. These tracts were a quarter of a mile east of the University Campus, extending from Oak Street to Prospect Park on both sides of University Avenue.

These tracts contained in all about 120 acres of land which was stated to be well suited to the needs of the University for an experimental farm. Later reports, however, do not bear out this opinion. Needless to say, perhaps during all this time the hardy, far-sighted pioneer farmers were aggravating the regents by their demands for support for their college, and for information about farming in the new environment. With an experimental farm provided, the regents were under obligation to secure suitable instruction in agriculture, and at the same time to initiate experimental work. Provision was made for teaching, and on December 8, 1868, they decided that the college course should be opened at the beginning of the next term and that a professor of natural sciences should take charge. To establish the fact that the provisions of the Morrill Act had been met, they gave public expression to their views in the following words:

"To give prominence to the Department of Agriculture and to take charge of the classes of applied chemistry and certain natural sciences, as are more closely connected with the agricultural course, the board has appointed Mr. Edward H. Twining, a professor in Washington College, Pennsylvania. Edward Twining has been a teacher in the Scientific School at Yale and comes with a warm recommendation of the faculty of that institution."

However, when the first freshman class was admitted, Professor Twining became the professor of chemistry. Not satisfied with this action as fully meeting the requirements of the Morrill Act, the Board of Regents on August 23, 1869, voted to establish a "chair of practical and theoretical agriculture." Unfortunately, the appointment had to be deferred until the committee on faculty could recommend a qualified candidate for the position. At the next meeting of the Board, however, they elected Colonel Daniel A. Robertson, St. Paul, who had been one of the founders of the State Horticultural Society and who in 1866 was its first president. His election as professor of theoretical and practical agriculture was noted by the Society with gratification. During the second term of the year he gave lectures on agriculture, deliver-

ing four a week for the winter term and one a week during the spring term of 1870. No teaching was done in the fall term of that year, and he resigned on December 21.

Following his resignation, no competent candidate could be found for the time being, and in the following school year the Board resolved in March, 1872, that the chair of chemistry should be merged with that of agriculture at the close of the year. Apparently not satisfied with Professor Twining's qualifications for the position, he was called upon to resign. At that time the Regents publicly announced that the chair of chemistry had been combined with that of agriculture, and Dalston P. Strange, a graduate of the Michigan Agricultural College, had been secured as instructor in charge of this department. In this matter it is probable that the Regents were animated by motives partly of economy and partly by bewilderment or discouragement over a problem which had been a subject of bitter controversy, namely, the place of agriculture in the educational system.

View of Experimental Grounds, 1888, Showing Plots of Sugar Cane and Sugar Corn

The failure of the college to draw students, and of the farm to function as an experimental farm, brought criticism from the hardy farmers who had sponsored both institutions. So severe was this criticism that President Folwell found it advisable to attend a meeting of the State Horticultural Society in January, 1873, to defend the institution and apply for aid and counsel. In his report to the Regents in December of that year, he justified the course which had been taken as a matter of reassurance and made public his own ideas of agricultural education.

Under Professor Strange, the production of grain and vegetables had increased, crops had been sown, and fruit and forest trees were set out. Tests were made of varieties of wheat and oats sent from the U. S. Department of Agriculture in Washington. None of the results of these investigations, however, seem to have reached form for publication. The complaints that there were no facilities for the work were thought to be fully met by the erection of the new agricultural college building begun in 1873 and completed for occupancy in 1875. This was a building 54 feet by 54 feet, 3 stories high, and with two wings, each 25 by 40 feet. The upper story was devoted to lecture rooms and to a collection of agricultural and chemical technology. The first story was divided into recitation rooms for botany and chemistry, and for experiments for the geological survey and experimental farm. The east wing was a plant house, and the west wing, a laboratory—"the latter planned with great care to afford excellent accommodations for students pursuing applied chemistry."

WILLETT M. HAYS

Elected assistant in agriculture, Minnesota Experiment Station, in February 1888. Served as vice chairman of the station, 1893-1904, and was assistant secretary of agriculture, United States Department of Agriculture, under James Wilson, 1905-1913.

Considerable emphasis was given to the work, when on December 15, 1874, Charles Y. Lacy, Bachelor of Agriculture, Cornell University, was appointed instructor in agriculture. He also was placed in charge of the experimental farm. Under Professor Lacy the experimental work was considerably expanded, as indicated by his reports in 1875 to 1879, inclusive.

The defects of the new University Farm had gradually become apparent. Much of the land was swampy or sandy. "A good variety of soil" proved to be true as to number of kinds, but not as to quality of soil. In spite of instruction within the University, the farm was not as accessible as had been hoped. President Folwell referred to this matter on one occasion by saying, "I take occasion to remark that the separation of the farm from the University by a wide stretch of unsettled territory (¼ mile), difficult to traverse by reason of drifting sands, renders it impossible to employ cheap labor. Any young man

would be glad to work on the farm if he were not obliged to consume time and expense in getting to and from it. If any kind of manual labor system is at any time to be introduced into the agricultural college, the farm and the college must be approximated by other experimental grounds provided they shall be more accessible."

Professor Lacy pointed out the unsatisfactory quality of the soil and called the attention of the Regents to the necessity for acquiring livestock of different kinds and varieties for instruction and illustration. He pointed out also that the farm was inadequate in size for the purpose and that additional land should be purchased. At various times Mr. Lacy urged strongly upon the Regents the unsuitability of the farm and advised its disposal, with a view to purchasing one of better quality. He advanced his reasons for this recommendation and pressed the importance of a new site. No action was taken, however, during his tenure, and becoming discouraged with the general situation and failure of promotion in salary, he resigned his position in 1880.

Samuel B. Green

Elected horticulturist of the Minnesota Experiment Station in April 1888. Made dean of the College of Forestry in 1910, only a few weeks before his death.

Because of necessity the Regents had attempted to economize in the management of the agricultural department and had refused to increase Professor Lacy's salary. His retirement, however, did not remove the difficulty. Agitation arose for maintenance of the department which resulted in considerable increase in expenditures. This agitation seems to have arisen in part from Professor Lacy's efforts to stir up interest in the department. In this matter he doubtless had the assistance of a number of others likewise interested in the development of agricultural instruction and experimentation. That there were differences in point of view between Professor Lacy and the Board of Regents is indicated by a report he made on the agricultural college at the last meeting of the Horticultural Society, at which he officiated as secretary in 1880.

Some difficulty was experienced in finding a successor to Professor Lacy. It was not until January 13, 1881, that a suitable candidate was

presented. At that time Regent John S. Pillsbury made a verbal report of an interview of the committee with Prof. Edward D. Porter of Delaware College. That the report of the special committee was highly favorable to Professor Porter is indicated by the fact that the board by unanimous ballot elected him to the professorship at a salary of $200 per month and the privilege of living in the farm house, rent free, during his tenure, if and when such building was erected. He was also voted $200 to cover moving expenses. This action indicates that the Regents believed Professor Porter to be well qualified for the work ahead and that they were anxious to quiet the severe criticism from farmers and farmers' committees and from the public press.

Professor Porter's work was at first exploratory. Under his predecessors there had only occasionally been an attendance of one to three students in the department, none of which was above the classification of a junior. The department had been inactive for nearly a year just previous to his arrival, and no students were enrolled. During the winter months following his arrival, he devoted his time to attendance at the sessions of the State Legislature and the annual meetings of the various agricultural organizations. From those he attended he has enumerated the State Agricultural Society, the Horticultural Society, the Amber Cane Growers' Association, the Wool Growers' Association, the Dairymen's Association, the State Forestry Association, and the Grange. That he believed these contacts helpful is indicated by his first report to the Board of Regents in 1881 in which he said:

> "Attendance upon these meetings and sessions made me acquainted with the representative men of the State in these several departments of agriculture. With their views and wishes as to the relations of their industries to the State University, it gave me an opportunity of meeting their objections and securing, I think, their earnest cooperation in our work. It is vitally important for the future of agriculture that an intimate relation be secured and maintained with all these organizations. Such relations now exist."

His personal interest in their affairs was indicated by securing membership in each of them; by his service as secretary and scientific advisor for the Amber Cane Association; and by the fact that at their request he was working on a scheme for unification of these associations. The Regents expressed their confidence in his efforts by naming him as a delegate to represent the first three societies named above, at a convention of agriculturists to be held in Washington, D.C., in January, 1882. This was also taken as an expression of their desire to keep in touch with the organized agricultural interests of the state and country, for which purpose they requested him to act as intermediary.

Professor Porter immediately set out energetically upon the gigantic task of popularizing agricultural education and at the same time de-

veloping the experimental farm, and a body of scientific knowledge related to farming. In this work he solicited the assistance of the organized agricultural societies and of the best farmers he could contact. The more helpful of these organizations was the State Grange. This organization appointed a committee of representative farmers who visited the farm frequently and fought valiantly with him for the establishment of practical courses in agriculture that would attract farmers and farmers' sons, and for the support and successful operation of the experimental farm. This committee holds an honorable place in the history of agricultural education and research, and their names have been memorialized in the halls of the agricultural campus. It is not surprising to find the Honorable W. S. Chowen at the head of this committee. His colleagues were John D. Scofield and James A. Bull.

Professor Porter, in the spring of 1881, began work on the experimental farm. He found, however, that the Board of Regents had been convinced that the farm was not suitable for experimental work; that there was much criticism from the farmers as to its quality and that the Board was doubtful of the wisdom of retaining it. While the results of the first year's croppings and tests were satisfactory, Professor Porter added his recommendation to that of Professor Lacy, that the farm be sold. The arguments used for the sale of the farm and for the purchase of a new one are too long to be included at this time. They have been brought together, however, and will be included for publication in full at a later date. It is sufficient to say at this time that by the spring of 1882 a movement was in full swing for the sale of the old farm and the purchase of a new one.

It was at this time that President Folwell advocated, through a written statement, the abandonment of the University Campus, and the removal of the University to a more favorable location. While no definite site was mentioned as an alternative in this address, it was understood that he had in mind a tract of about two sections of land on the north shore of Lake Minnetonka. This, it was thought, would afford a splendid site for the college, and ample land of good quality for experimental work in agriculture. The Morrill Act, binding together the agricultural college and the experimental farm, seemed to necessitate the two going together. Inability to find good land near the University site, the encroachment of railroads, and the loss of products and of property through the thievery of adjacent dwellers, prompted this advice. The fact that a constitutional amendment would have been required to permit removal, coupled with the local opposition of influential Minneapolis citizens, were serious obstacles to removal. The location of the first farm, separated by only a quarter of a mile from the campus, and even of the Bass tract, then under consideration and

only two miles away, could still be interpreted as near the University. But the removal of the whole campus to Lake Minnetonka could scarcely have been reconciled to the existing law.

With this proposal quieted, the Board of Regents authorized the executive committee to negotiate for the purchase of the Bass farm (the present site), the purchase to be made out of the proceeds from the sale of the old farm. On June 2, 1882, the committee reported that they had come to terms with the owner, and the purchase of the first 155 acres of the new farm was made. In his second report, Porter called attention to the necessity for more land and urged its immediate purchase. The Regents thereupon authorized the executive committee in its discretion to purchase additional land adjoining the new University Farm, not to exceed 160 acres. In the following March the committee was given full power to act in regard to the specific tract known as the Langford farm, containing about 92 acres. This tract was purchased and brought immediately into use as meadow and pasture. An additional 40 acres known as the Poehler tract, lying to the west of the Langford tract, was also authorized but not purchased. Twenty acres of this tract was later purchased (1905) and is now the site of three substantial brick buildings, tennis courts, lawn, and horticultural grounds.

OLAF SCHWARTZKOPFF

Elected veterinarian, Minnesota Experiment Station, October 1888. Resigned in 1891 to organize College of Veterinary Science in the University of Minnesota.

The new farm was regarded as admirably adapted for the purpose of an experimental farm and station. The agricultural organizations gave full approval to the selection.

Professor Porter entered with zeal and energy upon the development of the new plans. Here his education in the arts and engineering served to advantage in developing the plans for the building and in laying out the farm for the purposes intended. Out of the proceeds accrued from the sale of the old farm was erected first a farm house and superintendent's headquarters, started in 1883 and completed in 1884. This building now serves as the Agronomy Building. The main barn, of great magnitude and beauty, if not of utility, was next erected. This was completed in time to store the crops grown on the farm in 1885.

It is significant that the barn included two silos which were not finished until September, 1886. Thus, Minnesota, within ten years of the introduction of silos in the United States, had provided for studies of this new method of storing forage. With the buildings erected and feed provided, the next venture was to equip the farm with livestock. This, Professor Porter immediately set about doing, and by the end of 1886 he reported the purchase of very fine specimens of Shorthorn and Holstein breeding cattle, Shropshire sheep, Berkshire, Poland China, and Duroc Jersey swine, Plymouth Rock chickens, and Bronze turkeys. He reported also a herd of 30 young grade cows or heifers, all coming into profit, and the production during that season of 3,000 pounds of butter. Owing to the necessary development work, not much more was done during the first three years of occupancy. However, some truck crops were grown, tests of potato varieties were made, vineyards planted, orchard trees set out, and the grounds about the buildings landscaped. By 1887 a considerable orchard was planted containing Russian apple trees and Russian pears in the search for suitable long-keeping winter-hardy stocks. Local varieties of apples, plums, and the bush and vine fruits also were planted, and a good start was made in testing the truck crops needed for the rapidly growing Twin Cities adjoining.

OTTO M. LUGGER

Elected chief of the Division of Entomology and Botany, Minnesota Experiment Station, in May 1888, after service in the Bureau of Entomology, United States Department of Agriculture.

Establishment of the Experiment Station

During the early 80's there was much agitation the country over for the establishment of federal support for agricultural experiment stations. In anticipation of the passage of such an act by Congress, the Minnesota State Legislature in 1885 passed an enabling act establishing an agricultural experiment station. The act reads as follows:

"Section 1. It shall be the duty of the Board of Regents of the University of Minnesota as soon as practicable after the passage of this act, to establish at said University an Agricultural Experiment Station for the purpose of promoting agriculture in its various branches by scientific investigations and experiments, which station shall be under the control and supervision of the said Board of Regents, and of which the professor of agriculture shall be general superintendent."

That part of the act making the professor of agriculture the general superintendent was eliminated under a legislative act of April, 1889.

Because of limited funds and inadequate staff, little progress was made in establishing such station until the passage of the Hatch Act by Congress, which was approved on March 7, 1887. The provisions of this act carried an appropriation of federal funds in the amount of $15,000 a year in each state for the express purpose of conducting investigations in agriculture and closely related subjects. The Board of Regents accepted the provisions of this act and thus the Minnesota station became one of a national family of agricultural experiment stations.

Spurred on by the acquisitions of these funds, the organization of the station was rapidly pushed forward. During the year 1888 the first experiment station building was completed. During that year, also, the first experiment station staff was selected. It consisted of Prof. E. D. Porter, director and agriculturist; Willett M. Hays, B.S.A. Iowa Agricultural College, assistant in agriculture, February, 1888; Samuel B. Green, B.S. Massachusetts Agricultural College, horticulturist, April, 1888; Otto Lugger, Entomological Bureau, U. S. Department of Agriculture, entomologist and botanist, May, 1888; Prof. David N. Harper of the University of Pennsylvania, Chemist, July, 1888. In August, Dr. Michael J. Treacy, a graduate of several of the veterinary colleges of England was selected as veterinarian, but he served only two months and withdrew because of ill health. His place was filled by the choice of Dr. Olaf Schwartzkopff. These constituted the first staff of the agricultural experiment station of the University of Minnesota. They came into the work under the inspiration of a great leader, and themselves in turn became inspired and laid well the foundation stones of this lasting and permanently useful institution.

From the very first demand for an experimental farm, education in agriculture and agricultural research were closely associated. Thus it continued through the formative days preceding the establishment of the experiment station. Thus it has continued on through the years to the present time. Notwithstanding this sort of affiliation and increasing demands for instruction, the work of the experiment station and the development of agricultural research have gone steadily forward under organized support and supervision. The agricultural experiment station movement stimulated by the passage of the Hatch Act providing $15,000 annually to each state for agricultural research, gave opportunity for organization, and carried permanent support. Supervision of these federal funds through the Office of Experiment Stations, created in the Department of Agriculture at Washington for the pur-

pose, has given direction and coordination of effort. This has led to a permanency and stability in research which would not otherwise have been possible in many states had they been dependent entirely upon state legislatures for support.

View of the Crop Nursery at University Farm, 1910, Showing Centgeners of Grain in Process of Harvesting

The demand for research and experiment in agriculture seems insatiable. Professor Porter recognized the fact that the farm in St. Anthony would not provide for the needs of the state. He called the attention of the Board of Regents to the length and breadth of the state, to the variations in soil and climate, and to the impossibility of the findings of one location applying to all other locations in the state. Thus was inspired the demand for branch stations, later fulfilled by legislative enactment and University action. Professor Porter was a man of driving action, energetic, persevering, and insistent. He was well ahead of his time in vision and imagination and had used University money freely in establishing and building the experiment station. Differences of opinion grew up between him and the Board of Regents, and feeling that he had accomplished his objective and that the work would be better advanced under someone else, he offered his resignation in April

1889, to accept a position as Dean and Director of the Missouri College of Agriculture. Thus he passed from Minnesota, leaving as a monument to his foresight, energy, and wisdom, a well founded and permanently established agricultural experiment station. To his constructive leadership may be credited also the establishment of the Farmers' Institute of early days—now agricultural extension—the practical school of agriculture, and the foundation for our increasingly popular and useful college of agriculture. He had succeeded as no other had been able to do in popularizing agricultural education and research.

A Period of Retrenchment

Under Porter's directorship, money, accruing in much larger quantities from the sale of the old farm than had been anticipated, had been expended freely, and, in the view of the regents, somewhat extravagantly. Times were hard and even the farmer committees and advisers were somewhat perturbed at the cost of the institution and its maintenance. Upon Porter's resignation, a period of close economy set in. The Board selected as his successor Prof. N. W. McLain, LL.B., from Indiana.

Under pressure for economy in management, there was little expansion during his short term of office. The staff just then developing special lines of research found great need for funds and chafed under the restrictions imposed. Friction arose between the members and the director, and with confidence shaken in the wisdom of the selection, McLain's resignation was accepted in the spring of 1891.

The directorship was next filled by the appointment of Clinton D. Smith, M.Sc., Cornell University, who had been highly recommended as a good farmer and dairyman. These he proved to be. Again differences arose between the director and vigorous-minded staff members over policies of research, administration, and provision of funds, and the division of duties. Receiving an offer of the directorship of the Michigan Agricultural Experiment Station, he resigned in July, 1893, to accept the position. But little advancement in research was made under his administration, though some expansion occurred. Under his jurisdiction, however, two members of staff were added who later won great distinction for themselves and the station. These were Prof. Harry Snyder, selected by Director Smith as chemist to succeed Dr. Harper, resigned, and T. L. Haecker, to take charge of instruction in dairy products. On Smith's resignation, Haecker was assigned the whole field of dairy husbandry, in which field his work won international recognition.

A Period of Growth and Stability

Following Smith's resignation, no appointment to the directorship was made. Instead the staff members organized as a unit, known as the Experiment Station Corps. These staff members, young, ambitious, aggressive, and some of them, at least, inspired with enthusiasm for the rapidly developing agricultural science and education, needed a steady hand at the helm as was indicated by the experiences of previous directors. Col. Wm. M. Liggett, with large farm interests in Swift County, previously secretary of the State Agricultural Society and at the time State Railroad and Warehouse Commissioner and a member of the Board of Regents, was asked as chairman of the Agricultural Committee of the Board to act as chairman of the Experiment Station Corps. This he did with great satisfaction to the Board and equal satisfaction to staff members for a period of three years. W. M. Hays, who had been absent for a year and a half in organizing station work in North Dakota, returned at this time as agriculturist and vice-chairman. In 1896, in recognition of his successful administration, Liggett was requested by the Board to give full time to the University Department of Agriculture as Dean and Director. In this capacity he served creditably until failing health compelled his resignation in 1907.

N. W. McLain

Elected director of the Minnesota Experiment Station and superintendent of the Experimental Farm, March 1889. Resigned from both positions February 1891.

While not trained in the sciences, Liggett was in sympathy with the spirit of research and administered affairs with understanding and good judgment. He brought to the office dignity and respect, and because of his wide acquaintance and good standing in agricultural and political circles was able to advance rapidly both the educational and research plans of the Agricultural Department. It was under his able administration that the School of Agriculture was made co-educational (1897) and that the branch station policy suggested by Porter, and advocated insistently by Hays, was adopted (Coteau, 1894; Grand Rapids, 1896; Crookston, 1896). As a member of committees of the Land Grant Col-

lege Association, he was an able advocate of the Adams Act passed by Congress in 1906. This act under strict limitations as to use provided an additional $15,000 a year to each state experiment station from federal funds. It was under his jurisdiction that the foundation was laid for the monumental work of Hays in plant breeding, Green in fruit breeding and forestry, Haecker in dairy feeding, and Snyder in cereal chemistry. It must be said of Liggett that he was a good provider and and an able administrator and executive.

During Liggett's period of illness, he was aided greatly by Secretary E. W. Randall of the State Agricultural Society as member of the Board of Regents and who had succeeded Liggett as Chairman of the Agricultural Committee of the Board. Upon Liggett's resignation, Randall was elected to succeed him. In the year and a half that he served as dean and director, the institution advanced steadily along the lines laid by Liggett. The additional support for research provided by the Adams Act permitted expansion of staff and much needed intensification in the attack on fundamental research problems. It was under his administration and on the advice of the agriculturist that Plant Pathology and Agricultural Engineering were split off from the Division of Agriculture and established as new divisions in the interest of more highly specialized and intensive research. This action brought to the campus E. M. Freeman who has since gained international recognition for himself and for the division so effectively developed by him. It also brought John T. Stewart, agricultural engineer, who laid the foundation for our now comprehensive, well-manned Division of Agricultural Engineering.

D. N. Harper

Elected chemist of the Minnesota Experiment Station in July 188. Resigned December 1891 to enter commercial work.

Randall resigned in December 1908 to accept the presidency of a life insurance company. He was followed as dean and director by Hon. J. W. Olson, State Superintendent of Public Instruction and ex-officio member of the Board of Regents. The election was not unanimous, and a faction of the Board consistently fought his administration, on the ground that he was neither agriculturally trained nor prepared in the sciences. Failing to reconcile the discordant spirits, he discreetly withdrew from the office after only a year of service, thus retaining the

respect and good will of his associates and avoiding further unpleasantness in the situation.

A Period of Stimulation for Science

Satisfied from previous experience that the institution had developed to a point where the directorship required a man schooled in agriculture and trained in the sciences, the Board set about finding a successor to Olson. Their choice fell upon Dr. A. F. Woods, a graduate of Nebraska University, trained in biological science and at the time chief pathologist and asssitant chief of the Bureau of Plant Industry, U. S. D. A. He assumed the directorship in February, 1910.

Bringing to the station knowledge of research methods, zeal for the work, and vision of needed investigations, Woods stimulated greatly the scientific spirit among staff members. The Adams Act provisions for research with liberal expenditures from University Support funds for the same purpose permitted expansion of the investigational work and at the same time increase in staff membership. The addition to the staff of such scientists as Thatcher, Gortner, Alway, H. K. Hayes, C. P. Fitch, and others was popularized by the organization of the Agricultural Extension Service and its eventual combination with the early established Farmers' Institute. Through this service the findings in research are transmitted into action on the farms of the state. The acquisition of three additional branch stations (West Central in 1910, Northeast and Southeast in 1912) broadened the facilities for research and enabled the station to serve more fully the farmers of the state. During this period, cooperative organizations were fostered and close contacts were made with farmers, many of whom offered their farms and services for use in investigations and trials in which they cooperated fully.

Under Thatcher, who succeeded Woods as dean and director when the latter was called to the presidency of Maryland State College in 1917, the same high standards for education and research prevailed. Owing to disturbances—the World War and general disquietude and uncertainty—no changes in physical equipment occurred. Changes in staff occurred from time to time, but the station was maintained in full effectiveness notwithstanding the wartime demands for men and service. Thatcher resigned in 1921 to accept the directorship of the Geneva, N. Y., Experiment Station.

On July 1, 1921, the Experiment Station administration came into the capable and efficient hands of the present director, W. C. Coffey. The Purnell Act passed in 1925 provided for additional federal funds in the amount of $60,000 a year. Under that provision, research in

Agricultural Economics, Home Economics, and Rural Sociology was included in the research field, and this work has been generously supported. With emphasis centered on well-founded research and service to agriculture, with a well-rounded program of research, education, and demonstration, with close contact established with the farmers of the state and in close sympathy and cooperation with the neighboring stations and the federal office and program, the station under Dean Coffey's able guidance bids fair to meet the hopes and high aspirations of the hardy pioneers who so earnestly, painfully, but valiantly struggled for its establishment as an instrument of service to agriculture.

THE NEED FOR AGRICULTURAL RESEARCH FIFTY YEARS AGO

Eugene Davenport, Former Dean and Director, Illinois Agricultural College and Experiment Station

In these days of scientific research into every conceivable problem of the universe and of life it is difficult to realize the comparative want of accurate information about agriculture in this country fifty years ago, or the public indifference to anything like systematic investigation of the problems besetting the great business of farming.

It is wholly impossible for the modern student to understand the role of experimentation in the development of American agriculture except as he understands the background out of which it arose. The writer may be pardoned a few observations, therefore, which may be helpful in reconstructing this background.

In the first place this is a new country and so far as our type of civilization is concerned it is yet the morning of the first day. The earliest settlers came here for freedom from what they believed to be oppression on the part of government. Liberty, not economic prosperity, was their dream for 150 years, and they were forced to fight a war with our best friends in order to achieve their objective. We of today can hardly realize that we were under English rule almost exactly as long as we have been free or that agriculture here in those early days had no problems demanding solution, or if it had, the people were not aware of it.

Freedom won, the next problem to possess this people was not the subjugation of a continent as is so often represented. It was the simple and individual problem of getting themselves homes. Verily, the problem that actuated your immediate ancestors and mine was not one of

social welfare or economic equality, but it was an overpowering and abiding desire to possess a "home of our own." They went out into the wilderness to get it, and in doing so they founded a new type of civilization. The land was new and there was no problem of fertility of humus or of erosion, hardly of weeds, insects or fungi. To "tickle the land" was to "reap a harvest." They planted their crops, began their harvests, killed their meat, weaned their babies and calves according to the phases of the moon or the signs of the zodiac and got along all right.

It took a lifetime to clear a farm in the timberlands, but when the settlers struck the prairie their aims enlarged to the ambition to get homes for all the children while land was still cheap and to be had almost for the asking. And so we spread over the great West till we bumped up against the Pacific and began to understand that HERE WE REST. All this without being conscious of an agricultural problem beyond the getting of land on which to build a HOME, the food supply being assured from the few surrounding acres.

Even so, the East, a little over 100 years ago, and in the days of the old apprentice system, began to feel the need of instruction in farming, and a few agricultural schools for boys were set up. They failed because there was so little that could be taught outside the fields and barns, even the school farm being but a feeble imitation of the real thing. So it was that the best thing for a boy to do, who wanted to learn to be a farmer, was to get onto a good farm just as his brother apprenticed himself to a mechanic and worked with him in the shop.

But the idea was sound and the impulse a good one. Like all good things it might be stunned but could not be killed. And a generation later it revived, this time in the form of a college for young men instead of a school for boys.

In four states the plan was launched almost simultaneously, in all but one after the manner of colleges of the day, that is, as private enterprises. The exception was Michigan, which quite by accident had included in its new constitution a clause obligating the state to open and conduct an agricultural college. And the same forces that put the clause into the constitution saw to it that the college was opened at an early date. It was ready for students in 1857 and graduated its first class into the war of the rebellion, every member of it.

But the idea was at work on a larger, a national scale, and, as we know, the Land Grant Act was passed and signed by Lincoln in 1862. It was quite the fashion of the times to endow worthy enterprises, public or private, with generous grants of public lands of which we felt we possessed an embarrassing surplus. So it was that we established a national system of instruction in agriculture and the mechanic arts and

in doing so fixed a principle to the effect that education is a function of governments as well as of the church and of benevolent individuals.

An excellent beginning this, both in theory and in fact. But where should a professor of agriculture be found and what could he teach? It must be remembered that, traditionally, there were only three college courses, one leading to the ministry, one to the law, and the other to medicine. It is true that already a kind of "culture course" leading to no particular career had been gradually evolving, built upon the old theological foundation, which means that up to the time of the founding of the agricultural colleges all collegiate instruction, even in medicine, was on the basis of philosophy, literature, the classics, and tradition, with almost nothing either in the form or the spirit of science.

It is true that in a few of the most advanced institutions chairs of chemistry had been established soon to be followed by those in botany, zoology, and geology. But colleges for the most part, met the new situation in education by appointing a single professor to the chair of the Natural Sciences, all of which leads Doctor Bailey to wonder what sort of creature would be a professor of the "Unnatural" Sciences.

To make more clear the situation confronting these new colleges, let me quote Doctor Beal in his history of the Michigan Agricultural College in which he asserts that this institution was the first to teach chemistry as an undergraduate subject and that in 1857. I cannot personally verify this assertion, but Doctor Beal was not a man to make hasty assertions.

Anyhow, things being as they were, where was the machinery for turning out qualified teachers in agriculture for these new colleges, devoted, for the first time to the education of the people who practice the industrial professions. There was no such machinery and no such men were to be had.

Some institutions solved the impossible problem of the professor of "Practical Agriculture" in one way, others in another. For example, Michigan appointed a man trained in medicine, Dr. Manly Miles, a veritable Moses in the subject and the most successful of the early teachers of agriculture. Illinois chose a newspaper man, New York chose a carpenter and called him down off a barn roof to make him teacher in the class room, while Massachusetts took a farmer from the neighborhood.

It is to the everlasting credit of these pioneers that they did as well as they did, for every one of them succeeded in making bricks without straw, for there was no suitable text. The first really useful book was Johnson's *How Crops Grow,* published in 1868, followed two years later by *How Crops Feed.* These two books reported the findings of European laboratory experiments on the nature of plant growth and its

relation to the environment largely from the standpoint of chemistry, certainly not that of the farm. Cast in chemical terms, they were teachable only by the professor of Agricultural Chemistry, certainly not by the best-intentioned farmer-teacher.

And so it was that what was taught in the agricultural classes was largely the art of farming, certainly not the scientific principles underlying the agriculture of a nation. Now as the art of farming means the various devices by which the farmer in different localities meets his conditions as best he can, it follows that there is no such thing as the art of farming, and a mixed class of students from various parts of the state would be amazed at many things the professor said when teaching the kind of agricultural practices with which he happened to be familiar. Altogether, this attempt to teach how to farm was but an indifferent success, and stress was gradually placed on other phases of the general subject such as the history of breeds, which made good busy work as we call it now. One ingenious professor kept his students busy by counting the number of seeds in a pound for various crops.

But matters were progressing, for in the last two weeks of my senior year at the Michigan Agricultural College in the good year 1878 I enjoyed two weeks of a new study to be ever afterwards known and designated as "Stock Judging." And what judging it was! Not until that year did we have a text of stock breeding, and while that astute student of primitive science, Dr. Miles, could not write a poor book, even so it was but a passing contribution to what soon became a rapidly developing subject including plants as well as animals.

As time passed, the troubles of the unfortunate "Professor of Practical Agriculture" increased instead of diminishing. The several sciences, all of which bore more or less directly upon his subject, were all developing rapidly and his students were acquiring a distinctly scientific attitude of mind. They were in daily contact with new knowledge as the result of researches in the fields of chemistry, botany, zoology, and the various other "ologies," the teachers of which were not slow in acquainting their students with the latest findings in their fascinating fields. Not only that, but most subjects were offering "laboratory courses" in which the student could feel for himself the adventure of going after new knowledge by knock-down methods. What a contrast to the static condition of agriculture.

In this way, and as the result of experience of the various colleges, the necessity of research in the affairs of field and barn in order to replace fancy and tradition with facts and principles was expressed. In this spirit, and as a forced necessity, a few states founded experimental fields or stations as necessary adjuncts to the agricultural college. And soon this experience became massed into a universal demand that Con-

gress supplement the college system by an adequate system of experiment stations. A quarter of a century of trying to make bricks without straw, in agriculture, while other subjects, particularly collateral sciences, were making rapid progress on the basis of assured facts made this demand inevitable. And so came about the Hatch Bill, in whose passage both professors and presidents were active influences, among them your own President Northrop.

And now I come to the tragedy of the situation. During all those years when students and professors alike had been suffering from the lack of suitable material of a scientific nature and when the little that was available was written from the chemist's point of view and not the farmer's, there was, just across the water, a mine of information covering the principal problems of the farmer—all the result of the most careful experimentation, both planned and executed from the farmer's point of view.

For Lawes' and Gilbert's experiments at Rothamsted had been in operation a full 25 years when the Land Grant Act was passed, and it was another 25 years before Professor Fream's little book published in London in 1887 brought to the general student these most remarkable results in all the world for their bearing on the problems not only of farming but of agriculture as a national industry.

Here were the results of raising all sorts of agricultural crops in succession and in rotation and under all sorts of fertilization in various amounts, together with the influence of season and of previous cropping. Besides, there were the findings from most exhaustive feeding experiments, findings which we were many years in verifying.

I say this is a tragedy because we were in such frightful need of this information that had been piling up for 50 years before we made any effective use of it. These experiments had been in operation for 30 years when *How Crops Grow* was published, yet not a word of mention, and *How Crops Feed,* published two years later, gives but a single page casually to one of the features treated. The Rothamsted experiments had been going for more than 40 years when I finished the course at Michigan Agricultural College, yet I am not aware that I ever heard of Rothamsted or of Lawes and Gilbert till a decade afterward. All this though they had published more than 100 exhaustive papers in various European journals before the passage of the Hatch Act in 1887. What might have been saved had our professors of agriculture generally known of these experiments and had used them as they might have been used!

Even Professor Storer in his excellent work on agriculture, published in 1888, made but slight and casual mention of these greatest of all

sources of information bearing on what we were one day to call the science of agriculture.

Those of my generation had learned in college to divide plants into nitrogen producers and nitrogen consumers, but what was the difference in function we had not the slightest idea. It was in 1889 or 1890 that I saw a letter written by Sir John Lawes to Dr. Miles discussing the so-called "nitrogen mystery." In this letter he pointed out that most of the plants best suited to human food belong to the nitrogen consumers; that England had long been importing its stock of combined nitrogen in the form of guano from the Pacific islands where it had been accumulating for thousands of years; that the supply was already running low and that unless this mystery could be solved before the rest of the world should need combined nitrogen as badly as England needed it, then it was only a question of time, and that not very long, when mankind would suffer for something to eat.

It was only two or three years later that Mrs. Davenport and I saw at the Rothamsted laboratories the original clover plants through which the nitrogen mystery was solved, and Dr. Gilbert spent an hour repeating to us the lecture he had given in Halle a few days before telling the whole story of nitrogen and confirming Hellriegel's conclusions and recalling to me my old teacher's opinion in botany to the effect that these tubercles on the roots of leguminosae were probably a form of disease that should be "bred off."

Not only have the experiment stations afforded high-grade teaching material, as was the first intent, but they have solved many an agricultural problem that would otherwise have gone unsolved. Not only that, but they have discovered and identified problems and thereby forestalled many a disaster. But the experiment stations have done an even greater service than this, a service whose value is far beyond computation.

I refer now to what may be called the "scientific spirit" among farmers in general. I can best make my meaning clear by an illustration. When I was professor of practical agriculture in Michigan Agricultural College in 1890, I had neither secretary nor stenographer but conducted with my own hand, with pen and ink, all the correspondence that went out from the largest agricultural department in the Union. Nor did I write a letter every day either. Curiosity was not abroad in the land. Farmers were proceeding by empirical methods, by tradition and by signs. They were not curious about better ways, nor were they keen to know the WHY of things; the HOW was sufficient.

When we realize the thousands of letters sent and received these days by any agricultural college and recall that thousands if not millions of farmers are awaiting the last word from the experimental field or

laboratory, it is then that we begin to realize that the greatest achievement of the experiment stations, as well as the greatest service has been in creating and fostering the scientific and experimental spirit on the part of the masses of American farmers.

Does it seem impossible that these things, the solution of the nitrogen mystery for example, should be so near to our own time? Let me indulge in a few backward glances, whereby I have been obliged to convince myself of how fast the world is moving in these later days since science has really gotten at work.

For example in my first attendance at farmers' institutes it was a rare experience for a discussion to proceed far until it would develop an argument about wheat turning to "chess." Cows no longer had "holler horn" or "wolf in the tail" it is true, but the heated horseshoe was long held to have potent influence over witches. Not a few of my personal friends in the old days killed animals or moved only on the increase of the moon. Of course those same people would be the first to disclaim adherence to such tomfoolery now—another result of living experimentally minded for a quarter of a century or so.

Indeed, most of the knowledge and the equipment of today is far newer than we realize except as we pinch ourselves from time to time in recollection or take a backward glance in history. For example, how many people now realize that the first photograph of a human face by natural light was not taken till 1840?

My old teacher in college, one of the best chemists of his time, gave it as his opinion that electricity would never be of any practical use except for telegraphy. That was in a class in chemical physics in 1877. Then there were 62 chemical elements, and we thought of each as "indivisible" and probably much like a marble in character. Oxygen was not discovered till 1774 and I knew at least one man who was born only two years later, and I am not quite an octogenarian yet.

Do we realize that disinfectants were not in use when the Land Grant Act was passed, or that the Civil War was fought mostly without anesthetics? Or that when men of my own age were studying surgery, the repeated injunction was to "keep out of the abdominal cavity?" I was amazed only a few weeks ago when it came to me with a start that when my own mother was a young woman there was no place in the United States where she could have gotten the equivalent of a modern high school education. And I was even more amazed to realize that when I myself was born there were not a half dozen colleges in America that would admit a woman and then only to courses designed for men.

It is only by looking backward, even a little way, that we can come

to an understanding of the fact that about everything we have in use today has either been invented or so greatly modified as to be essentially new and within the recollection of men yet living. The world has been moving with lightning speed since science was set at work, and unless agriculture had kept reasonable pace we should have been living in a kind of double-headed world by this time, with no assurance of an adequate food supply and with the men and women of the land a kind of inferior species set apart as hewers of wood and drawers of water.

To recapitulate briefly then: The great service of the Agricultural Experiment Station has been, first, to afford adequate material for the class room; second, to solve some of the farmers' problems; third, to contribute to the certainty of an adequate food supply for the nation, and, fourth, to develop and spread the "spirit of research" and a respect for facts as against tradition among the farmers of a free and self-governing people.

THE NEED FOR THE EXPERIMENT STATION THEN

J. H. Shepperd, President, North Dakota Agricultural College

Dean Coffey informs me that the "now" and "then" of the Minnesota Station are to be discussed, and I am to cover the "then" which I assume is the period from 1885 to 1895.

The colleges of agriculture during that period had developed into the triumvirate of resident instruction, experiment station, and extension, altho the latter paraded under the title of "Farmers' Institute".

The experiment station was, and still is, the least understood by officials and the general public. For 15 years I was engaged wholly in experimental work. Early in September intimate friends among Fargo townspeople would say, as we met on the street, "Well, I see you will have to go to work September 20," referring to the date when the college opened. I explained that it made no difference with my work, and they would immediately ask what I was doing. I would explain my work and as they looked rather blank I would explain the explanation, but a little later I gave it all up as hopeless and from that time forth agreed with them and let it go at that.

The agricultural world knew there were problems 50 years ago, but to get at them and to satisfy the public with the results was a formidable matter. I did not know the first Minnesota director—Edward

D. Porter—who was also professor of agriculture, and while I saw Director McLean, the second director, I know little of him. Clinton D. Smith I knew, and the first expert workers I knew quite well. They were W. M. Hays, S. B. Green, Otto Lugar, Dr. Schwartzkopf, and D. N. Harper.

The production and feeding of silage early received the attention of this and other experiment stations. The silo was filled to a depth of 16 feet and covered with a lid of double matched boards with tar paper between. The lid was of a size to allow a play of an inch on all sides and was weighted with sand bags at the rate of 130 pounds per square foot. The ensilage blower had not then been invented, and it was hard to elevate the green heavy corn high enough to secure the depth of silage that we are now accustomed to and consider necessary.

Neighboring stations were equally puzzled as to how to proceed.

As a student at Ames, I used to see their first director, Captain R. P. Speer, trudge to the orchard with a hoe over his shoulder as the leader of a crew of men to work among the trees each forenoon. I fancy he spent the afternoon at office work. His successor, Tama Jim Wilson—later Secretary of Agriculture in the Cabinet of the President of the United States for 16 years, used to quote Speer as saying, at the close of a calf feeding trial in which he had but two calves, "the wrong calf came out ahead in spite of the devil."

J. L. Budd of the Iowa Station had been to Russia and brought many fruit tree scions from the steppes, and Minnesota as well as Iowa was occupied in a searching of this list and many others through trial for successful hardy fruit.

Dairying early claimed the attention of the Minnesota Station. I was working here at the Minnesota College when they were considering Prof. T. L. Haecker as a man to begin work on dairying at this station. A few months later I was a graduate student in agriculture at the Wisconsin University—the first graduate student in agriculture Wisconsin University had ever matriculated. While there, Dean Henry told me that Haecker came to him asking what salary he should demand from Minnesota. I shall never forget Henry's reply. He said, "Make no argument over salary, Haecker. The thing for you to do is to get your finger into that institution." Then he said to me, "Now look at him. He has his whole arm in."

As a senior student with Prof. Geo. E. Patrick at Ames, I was startled one morning when as a class of three members we entered his classroom and he blurted out, "Young men the Patrick milk test is only history. Dr. Babcock of Wisconsin has one making use of centrifugal force which will occupy the field." That was in 1891. In 1892 I was making cheese in the dairy course at the University of Wisconsin, and

Dr. Babcock and Governor Hoard came into the laboratory. I overheard Hoard say, "Dr. Babcock, you lost a million dollars by not patenting that milk test." Babcock replied, "I didn't lose 10 cents. You can't patent centrifugal force, Governor, and that is all I had more than Patrick and Shortt used in their tests."

As an old man of 84 winters, Dr. Babcock said to me, "It's strange that I should have had the luck to make the bottle calibration and the acid measure so that they have not been changed in the 30 odd years that have come and gone since I brought them out." That invention opened a field for study that has brought practical improvement that the entire world has appreciated.

Silage making was soon mastered and gave the feeder something to use as an easy substitute for the sliced roots so successfully fed by his British cousins.

J. W. Sanborn of the Missouri Station at about the same time discovered by experiment that one can feed pigs so as to change, very appreciably, the proportion of fat to lean in the carcass and so that litter mates will have firm bones and brittle bones, according to the ration supplied.

In the lobby of the old Transit House at Chicago, Dean Henry, on a midweek evening during the International, gathered a group of us young men together saying that he wanted to give us a bit of tradition—that should never be printed—relative to the trying times the early experimenters had in securing apparatus with which to work. He said that in the Colorado Experiment Station the Board held an investigation and asked the experimentalist to explain his trial in feeding pigs. The scientist explained that he had no scale upon which to weigh the pigs when the trial began but that he and the caretaker had taken each pig by the hind leg, hefted him, and set down his estimated weight. He explained that each had made his estimate without consulting with the other and that their estimates had agreed reasonably well, but that at the close of the trial they had secured a platform scale and by setting a crate on it had taken actual weights.

I recall that in the year 1900 I wrote in a North Dakota Station report that alfalfa was not hardy there and advised against attempting to grow it. I had made trials with seed from all sources at my command for seven years and spoke with confidence. That very year Hays and Boss of Minnesota supplied me with Grimm alfalfa seed, which this Station had brought out, and as a result the entire Northern United States has a winter-hardy alfalfa.

Much time of the pioneer experimenter was spent in working out ways and means of procuring and measuring results, and it is difficult to estimate the value of such fundamental work.

Once when I was "browsing around" at the Minnesota Station in 1890, Dr. Lugger showed me three beds of flax growing in a greenhouse. The middle bed was dying with what I know now was flax wilt. The two outside beds were vigorous and nice. I asked what caused the trouble in the middle bed. Dr. Lugger replied that all that he had proved was that it was attacked by some living enemy. He had made an ooze from the dead flax plants and watered the middle bed with it. The right-hand bed had been watered with tea brought to the boiling temperature and was perfectly vigorous and hardy, while the third bed also vigorous and healthy had received no treatment whatever. So far as I know, Dr. Lugger never proceeded further with this study. He was at heart an entomologist and found much more satisfaction in studying insects than he did in pursuing research with plants. Almost every worker in those days had to cover two fields at least.

I recall a conversation between Director Clinton Smith and Director W. A. Henry, who had been students at Cornell University together. Director Smith said: "When Henry got the combined position of professor of botany and of agriculture at the University of Wisconsin, he told us boys,. 'I'll soon get rid of that agriculture when I get out there.' " Henry replied, "I took two looks, Smith, and knew that agriculture was the big thing, once I got out there."

I have said that Dr. Lugger pursued the flax phenomena no further. But three years later when I signed up in North Dakota I told my associates Ladd and Bolley of what I had seen in Lugger's greenhouse. We arranged a triangular attack which identified the disease, found a way around it in producing flax, and saved the crop to the northwest, altho our Dr. C. I. Nelson is still working on the "why" and "how" of it.

In the Kansas Station during this same early period, Prof. C. C. Georgeson made an ingenious study of the time grain remains in the digestive tracts of cattle. He had the steers on a full grain ration of white shelled corn and at noon (12 m.), at 3:00 p.m., and in the evening (6:00 p.m.) gave them each 50 pounds of red shelled corn. He observed that the first red kernels appeared in the manure in 33 hours, the maximum in 51 hours, and that they disappeared in 96 hours.

At the New York State Station E. F. Ladd determined by a study of the corn plant that it stored dry matter, largely starch, at a remarkable rate during the period of growth from tasseling to ripeness, and that an increase in dry matter occurred at the following rate:

When tasseled it had 0.8 tons of dry matter per acre.
When silked it had 1.5 tons of dry matter per acre.
When in milk it had 2.3 tons of dry matter per acre.
When glazed it had 3.6 tons of dry matter per acre.
When ripe it had 4.0 tons of dry matter per acre.

Taking the tasseling stage as the unit of measure, his results showed approximately:

Double the amount when silked.
Triple the amount when in milk stage.
Four times the amount when glazed.
Five times the amount when ripe.

During that decade, Bolley at the North Dakota Station had discovered the corrosive sublimate treatment which cured scabbiness in potatoes and brought out the formaldehyde treatment for smut in wheat.

About forty years ago, a group of agricultural teachers met for a discussion in Prof. Thomas Shaw's new animal husbandry classroom in the new dairy building. Beside Professor Shaw's desk was a cement floor about 12x14 feet with a low curb around it. He said, with enthusiasm, that when he taught Angus beef cattle a specimen would be brought in; when Shropshire sheep were discussed, a Shropshire would be brought in, and when he was discussing pigs, a Poland China would grace the pit. The seasoned pedagogs asked: "Do you think you can maintain decorous order, Professor Shaw, with a pig in the room?" The professor with enthusiasm insisted that he could, while the other men murmured, "Well, maybe you can, but I doubt it."

I should perhaps remind you that John A. Craig started stock judging exercises in the United States in 1892 at the University of Wisconsin and that graduating from Iowa State in 1891 we had no livestock demonstration and no exercises in dairying, except to see a large cream separator discharge cream from one spout and milk from the other. The separator was not stopped for our inspection. I will say further that Loren P. Smith, a brother of Clinton, the director in Minnesota, was professor of agriculture and agriculturist of the Iowa Experiment Station at that time, with his general field limited only by having horticulture segregated from it.

An amusing incident occurred during one of the first national meetings of the Land Grant Colleges which I attended. The official name of the organization was all-inclusive and read: "American Association of Agricultural Colleges and Experiment Stations." The secretary, in desperation, reduced it to A.A.A.&E.S., which he had printed in large black letters and displayed prominently in the lobby of the hotel used as headquarters. The association wasted a couple of hours in a lively forensic and parliamentary battle over a motion to change the name of the organization. One of those arguing for a change said he had heard one traveling salesman ask another what group was meeting here and that the other replied that it must be a poker club since they made three aces so prominent in their announcement, all of which indicates that the association was not adverse to levity and a waste of their national time.

During the first 10 years the experiment stations had learned how to cure and use silage, had added alfalfa to our crop lists for the northern states, and had shown the world that corn adds feeding value at a rapid rate during the last stages of maturing, which meant that growing fodder corn is a mistake. They had learned that a station director can be better occupied than by swinging a hoe and that two calves are not enough to produce convincing results in a feeding trial. A study of the world's fruit was well under way, and hardy, productive stocks for the northwest were assured. Minnesota had established her fruit trial grounds at Minnetonka during that decade. The Babcock milk test had sent dairying on its way with assured measures and values both in manufacturing and breeding and had made its business transactions standard and dependable. The stations had learned the length of time grain food is processed in the digestive tracts of cattle and that fat and lean can be produced in pigs by the feeder and that he can strengthen or weaken their bones at will. Flax wilt had shown itself and had aroused the scientific curiosity which eventually saved that crop to the northwest. Potato scab had been conquered, and the present world treatment of wheat for smut had been discovered and announced.

Instead of one man covering the entire field of agriculture, it had been divided into at least four distinct sections with men specializing in each. Scientific men were meeting annually to reason together and to compare notes, even if they were mistaken for a poker club.

I do not apologize for the efforts of these pioneers in the experiment station, but instead I honor them for laying so firm a foundation for their successors to build upon.

THE NEED FOR THE EXPERIMENT STATION NOW

W. C. Coffey, Dean and Director, Minnesota Agricultural Experiment Station

The program of the experiment station deals with the biologic, economic, and social problems growing out of agriculture and rural life. As conditions change, new problems present themselves. As conditions become more complex, problems with increasingly difficult angles show up and the need for their solution becomes more acute.

In the public mind, the outstanding function of the experiment station has been to increase the production of plant and animal crops. In some respects the public was justified in getting this conception of the

work of the experiment station. Practically all the first demands made upon it were to solve difficulties being confronted in production. In some cases it was a matter of discovering causes of, and cures for, checks and disasters that had overtaken production. In others, it was a matter of discovering methods of overcoming the factors or circumstances standing in the way of production. With respect to the latter, the Minnesota station has displayed her genius in finding methods of overcoming limitations normally imposed by cold climate. She has more than repaid all she has expended for all purposes in the hardy varieties of field and fruit crops she has developed. In bringing forward these varieties and emphasizing their good points, the public would very naturally gain the impression that increased production is a major experiment station objective.

But perhaps the World War period did more than anything else to grip the public mind with the idea that the experiment station is concerned chiefly with the expansion of production. From every quarter came urgent pleas for maximum production in order that our soldiers and the soldiers of the allies might be fed. These pleas, supplemented by attractive prices, resulted in the quick application to production of facts brought out in researches made by experiment stations. The results left no room for doubt as to the efficiency of the results of agricultural research with respect to increasing producing power, and when the tables suddenly turned and surpluses replaced scarcity of agricultural products, this efficiency became lodged in the public mind as an obsessed purpose of the experiment stations.

The experiment station is not interested in increasing the total volume of production. Many times it has warned farmers against trends toward overproduction of given commodities. But since plant and animal life must always be given major consideration by each and every farmer engaged in agriculture, the experiment station could not function efficiently without devoting a considerable amount of time and energy to production problems. This being the case, it is not just to accuse it of being dominated by the motive of increasing production as it announces discoveries relative to production, even if its discoveries, as they often do, point the way to larger production per acre or per animal.

Under present conditions, the more prominent objectives of the Minnesota Agricultural Experiment Station are to conserve land resources as a continuing source of wealth; plan the use of land, keeping in mind the need of adjusting production to demand; reduce the costs of production and marketing; improve the quality and marketability of farm and forest products, and expand the use and market outlets for these products. These objectives pertain directly to land enterprises. There

are others addressed to problems involved in rural home and community life. When the work of the experiment station is appraised on the basis of these objectives, it is clear that there was never greater need for it than now.

Our land resources comprise our chief source of national wealth, and, therefore, their conservation is a national obligation. As we look back into the experience of older nations and into the history of civilizations that ran their course and disappeared, we see how fatal it is for a country to continue indifferent to the conservation of its land resources as a continuing source of wealth. In China, practically every fragment of material having fertilizing value is carefully conserved. We are likely to think that this zealous husbanding of fertility is due to necessity brought about by crowded populations. This is only partly true. In larger degree, it is due to the neglect of bygone years when forests were destroyed and the soil exposed to the merciless ravages of water and wind erosion. After the World War, the American Red Cross sent Cyril G. Hopkins, of the University of Illinois, to Greece to consult with her about ways and means of improving her agriculture. He found valleys, once widely reputed for their producing power, depleted to the point where the surrounding hills were more productive, altho these hills in earlier times were regarded as inferior for crop production. When Hopkins pointed the way by which the Greeks could in a measure recoup their soil losses, they were so grateful that they decorated him as a god. Dr. E. E. Novak, of New Prague, tells of an experience he had on a farm in Germany recently which profoundly impressed him. He saw a farm hand who received a very low total yearly wage ($10, I believe he said) working with several piles of fertilizer. He approached this man and asked him about what he was doing. To his amazement he told him what kind of fertilizer each pile contained, potassium here, phosphorus there, etc., and the kind of land and crop to which each was to be applied. To Dr. Novak, it was proof that Germany is awake as to the necessity for conserving her soil resources; and so it is, and so any nation must be if it has visions of progress and growth.

The experiment stations, Minnesota along with others, have done their full share in trying to arouse the country concerning the need of conserving our land resources and of handling the soil so that it can be truly regarded as a basis for a prosperous agriculture if other conditions are favorable. For many years, researches have been directed to elements of soil fertility and the food requirements of various crops. Soil deficiencies in view of crop demands have been determined, but the conservation of land resources does not stop here.

Years ago, it was realized that much land was being brought under

cultivation without sufficient knowledge as to its producing power. Also, that many farmers did not have adequate knowledge as to the treatment that their land should have to make it productive. This realization led to the inauguration of detailed soil surveys, promoted jointly by the United States Department of Agriculture and the various state stations. Briefly, the object of these surveys is to map the soil of every county and otherwise secure a sound basis for field and laboratory studies that will furnish complete and practical information regarding the use and management of every type of soil. In Minnesota, the federal government made a beginning in soil survey work in 1904. The University began cooperating in 1915 in Anoka County. The first special appropriation by the legislature was made in 1921. Ever since, special appropriations have been made. We shall have $7,000 per year for this purpose during the present biennium. At this rate, it will be possible during the biennium to complete the survey in two more counties of the size of Redwood or Renville. To date, 25 counties have been surveyed, leaving 62 still to be surveyed. It is my belief that the survey is going too slowly. I say this because it furnishes basic information on which the principles and practices for the conservation of the 50 million acres of Minnesota soils are being constantly developed. We should have at least $50,000 per year for soil survey work. Even at that pace, there will be impatience on the part of many for information that cannot be furnished until the survey is completed. As an example of one of the newer special uses being made of soil survey work, I quote from a report by Dean Mumford, of the Illinois Experiment Station:

"Illinois already has plans well under way for two national forest units involving 599,232 acres in southern Illinois. These plans would not be so far along were it not for a long-established project like the soil survey. Facts collected in the survey were used for blocking out these two units, and when the preliminary report was sent to federal forestry officials they proclaimed it the most complete one they had ever seen. If these national forest units materialize, they will be included in President Roosevelt's national reforestation program, they will employ hundreds of men in southern Illinois, they will take thousands of acres of marginal land out of production, they will relieve the counties and the state of maintaining roads and schools in the area, and the money that the counties will receive from the forests will mean far more than what they would ever have realized from taxes."

Conservation of our land resources depends in large measure on the wise use of land, which is not possible without knowledge of the soil and its needs, as I have already pointed out. But we have wasted land resources and dissipated human effort by assuming that almost any kind

of land is suitable for agriculture. It is only lately that we have begun to think seriously about marginal and submarginal agricultural land, the bases on which these lands can be distinguished from supermarginal lands, and what uses should be made of them. Our thinking along this line has been precipitated by declining markets for agricultural products, our apparent capacity to produce more than can be effectively marketed, and the low standards of living of those located on poor land. This matter of land use as it now occurs to us in the light of national and international developments raises many problems insistently calling for services of research along both technical and economic lines in several general fields, such as agriculture, forestry, wild animal and bird life, and recreational activities.

In my judgment, we shall never succeed adequately in conserving our agricultural land until we succeed in stabilizing agricultural income at a point where the standard of living on land properly classified as agricultural can be regarded as satisfactory in the light of living standards characteristic of the country as a whole, nor until we succeed in making country living the first and prime objective of those who reside on the land. We cannot conserve our soil resources by having them exploited by people who have no regard for them except as they are enabled thereby to reside in urban centers. Nor can we conserve them by having the land occupied by those who imprison themselves by slaving away looking to the day when they can retire to the city and when at least three-fourths of the members of their families can sell out and take the proceeds to the city to augment urban life at the expense of rural life. What I am attempting to suggest here is that farmers need to be concerned more about current income and using it wisely than the accumulation of capital most of which will some day take flight from the country.

But getting back to adequate farm income as a factor in conserving agricultural land as a national resource. The urge for a satisfactory standard of living is so great that the farmer will neglect his land, if he is forced to, in order to have it. Therefore, we cannot expect to maintain the soil under markedly adverse conditions, such as disparities with respect to prices and overhead costs. In securing income, the farmer owes it to the remainder of society to be efficient in all processes for which he is responsible, and under the stress of rapidly changing conditions he needs the assistance of all the facilities of the experiment station to attain and maintain a desirable level of efficiency.

Production and marketing.—Economical production and marketing are features in farming efficiently which make ever-continuing demands on farmers and the agencies that serve them. Farm cost accounting

studies indicate wide differences between farmers in their production costs under similar soil and climatic conditions. Some of our recent achievements in the breeding of corn and small grains and in the control of plant and animal diseases and insect pests indicate that much is yet to be gained in reducing production costs through improvement and control measures.

Weed control.—The control of diseases and pests has been significant also in connection with stabilizing production at the point of effective demand. Last year the drouth intervened to show how natural phenomena can interrupt and interfere in carrying out well-laid plans. Grasshopper invasions and the scourge of black stem rust have, on different occasions, caused so much damage that any organized plan of production would have come to naught in the regions where these devastations occurred. Therefore, a planned agriculture, well organized, calls for controls in other respects than acreage and numbers of animals.

Quality of product must receive emphasis along with the cost of producing it. In bidding for the consumer's patronage, the farmer competes with a vast army of producers, and quality is vital in successfully meeting competition. Since coming to this state in 1921, I have witnessed a marked tightening up with respect to quality of product. During the last session of the legislature laws were enacted on the grading of cream and potatoes for the purpose of securing higher and more uniform quality. We are far from having reached the upper limit of desirable market quality for a number of products. I refer to quality in more than one sense; first, as it exists in the product as grown—as in the case of fruits, vegetables, and cereals; second, as it is developed in processing—as in the making of products such as butter and cheese; third, in developing tests and processes in protection of quality, as developing herds free from tuberculosis and Bang's disease, a most outstanding research contribution from veterinary medicine.

At present one of our more prominent researches in dairy manufacturing is being directed at making a Roquefort-type cheese of uniformly high quality at comparatively low cost. Quality of product is an achievement Minnesota can be sure of because of favorable climatic conditions. It would be a great mistake to neglect the researches essential to gaining this achievement.

As the organization of society becomes more and more complex, the problems of marketing take on increasingly complex angles. In cooperative marketing, especially, Minnesota has been a pioneer. In this type of marketing she has made outstanding achievements which should be maintained and improved upon. The Minnesota Experiment Station was among the first to undertake research work in this field, and atten-

tion to marketing problems has been one of its continuous activities for more than 20 years. Studies relating to the marketing of grain, livestock, dairy and poultry products, and fruits and vegetables have been made. Cooperative organizations have come in for major consideration in these studies. There are many problems of research relating to them that should be undertaken.

Land use planning.—With the damming up of agricultural supplies and the drastic decline in agricultural prices, there developed a marked realization of the need for wise planning of the use of land and most especially at the point of adjusting production to effective demand. Programs of agricultural adjustment, up to the present, have been organized to include practically all producers who volunteer to take part. This requires cutting down crop acreages in all parts of the country, in regions both well adapted and poorly adapted to the production of the crops involved. Question is raised as to whether it would not be better to plan on a regional basis and thus confine the growing of given commodities largely to regions, which, everything considered, are best suited to their production. Such planning doubtless would bring about in time a considerable reorganization of agriculture. For example, one result might be the organization of agriculture on a still more intensive basis in one region and a still more extensive basis in another than at present. Last March 14 middle-western states met at Ames, Iowa, with representatives of the Federal Department of Agriculture to discuss this very important problem of regional and national planning in the production of farm products. Each of these states is now busily engaged in drawing together such data as they have which have a bearing on farm planning and management with a view to joining with the other states some time in the near future for the purpose of seeing what they can do to lay out a logical pattern of production for the region. Already it is realized that the problem is tremendously complex, and I can predict with safety that much more study will be needed before a fully satisfactory plan of regional production can be developed. Moreover, with changing conditions, the adjustment of local, regional, and national plans will be a continuing matter.

Last March, upon our invitation, experiment station workers from North Dakota, South Dakota, Iowa, and Wisconsin met with us to discuss the importance and need of pasture research. It was freely admitted by the workers from each state that pasture has been neglected by the experiment stations more than any other agronomic problem. And it was definitely felt that the use of pasture should be carefully determined and properly evaluated as we go into programs of planning. Through pasture utilization it may be possible to reduce unit costs and

at the same time cut down volume of production, if such is necessary in adjusting production to effective demand. This problem calls for attack along a wide front and if comprehensively handled would utilize workers in agronomy, biochemistry, plant pathology, entomology, veterinary medicine, animal husbandry, dairy husbandry, economics, farm management, and even engineering.

Despite the major importance of adjusting agricultural production to effective demand, the responsibility of the experiment station in land-use planning does not end here. It has a responsibility also in connection with the use of marginal and submarginal land. During the last few years much study has been given to the physical, economic, social, and political problems of the cut-over counties of the state. Constructive recommendations have been made relative to these problems. Programs have been suggested. The possibilities of forestry, wild life, and recreation, in addition to agriculture in the cut-over region, have been pointed out. Land zoning based on the uses to which land in this region is best adapted has been advocated in the interest of the settler and the economic functioning of the state in rendering various forms of public service such as schooling and the building and maintenance of highways. A zoning bill passed the house in the last session of the legislature but failed to pass in the senate. It is most likely that a zoning bill will be placed before the next legislature, and if what is taking place in other states in connection with marginal lands is any indication, it is fairly safe to predict that some such device as a zoning plan will be adopted in this state. Wisconsin already has a zoning law, which, I understand, is operating not to the detriment of agriculture in the cut-over region, but rather in sound furtherance of it on land sufficiently fertile and suitably located for farming purposes. Under federal encouragement and support we are relocating farmers who are on land that does not afford the possibilities of successful farming. This and other activities such as rural rehabilitation are helping to develop a sense of the propriety of zoning lands and closing areas unsuitable for farming to further settlement.

This new movement in the direction of zoning calls for additional service from the experiment station. First of all there is the call for the detailed service of the soil survey. As definite demarcation is made between agricultural and non-agricultural land, the question of uses for non-agricultural land becomes more specific and the demand for answer more insistent. Along with the federal government, we have the responsibility of determining the means of successful forest development and management. With the strides being made in the successful utilization of nearly all varieties of trees even when they are relatively small

in size, I cannot think that there is no future for forestry in Minnesota. But like any other crop growing from the ground, the forest crop will present problems in breeding, growing, disease, and management that will demand the attention of the experiment station.

The propagation and conservation of wild life is a comparatively new field claiming the attention of the experiment station. Much of our cut-over land is regarded as ideal for the propagation of wild life. One of the assets of the state is her power to attract thousands who come here for holiday vacations. The maintenance of wild creatures in our woodlands is a feature of attraction to out-of-state visitors and to our urban dwellers who haunt our land and wooded regions. It is clear that we cannot maintain our wild life at a desirable level merely by protecting it adequately from the hunter's gun. There are feeding and disease problems and still others which require quite as much attention as protection from overzealous hunters.

The industrial utilization of farm products.—Within the last few years there has been a rapidly growing clamor for the increased use of farm products in industry. In some notable instances the demand has been made for differential taxes to be levied against present industrial products made from agricultural crops. In such instances, the fact has been generally overlooked that the farming population is the greatest consumer of industrial products and that a differential tax would react upon the non-farming population.

In spite of what one might think from reading the daily press, the agricultural experiment stations have not been blind to the possibility of utilizing agricultural crops as sources of raw material for industry. The history of our experiment stations is replete with examples of their contributions to this problem. Only a few years ago, in the early days of our own experiment station, the sugar cane planters of the tropics and sub-tropics scoffed at the idea of a beet sugar industry which would seriously challenge their monopoly of the sugar trade. In old letters, now in the files of our own experiment station, there is definite proof that the cane sugar planters of Louisiana were afraid of the possibility of a sorghum sugar industry but did not fear a beet sugar industry because of the then low content of sugar in the sugar beet and because of the difficulty experienced in causing beet juices to crystallize.

However, agricultural chemists, including our own chemists, David N. Harper and Harry Snyder, co-operating with agronomists and plant breeders, kept at the task before them and eventually created the present beet sugar industry which in major measure is the product of agricultural chemists who had a vision at a time when visions were not generally approved.

The agricultural chemists have played a major, altho perhaps an inconspicuous role, in improving flax varieties for the production of linseed oil, in the improvement of corn for corn oil and glucose production, in the improvement of the soybean for its many industrial uses, in studying the methods of manufacturing casein on a commercial scale and in so standardizing it that it now is greatly demanded by industry, and in producing new and more efficient fertilizers to fill the need for fertilizing lands which they have shown to be deficient in the various elements necessary for adequate nutrition. All this and much more has the agricultural chemist contributed to the industrialization of America and to the promotion of the wealth and comfort of the farming communities. On only one thing have they constantly insisted, namely that there shall be a profit to the farmer in the application of their teachings. They have contended against the sale of potash fertilizer to the farmer when his soil already contained adequate amounts; they have advised against the purchase of nitrogenous fertilizers when the farmer can more cheaply grow his nitrogen in the form of legumes; and the majority of the agricultural chemists will for a long time insist that the farmer cannot afford to grow and sell his corn for industrial uses if industry can pay no more than one cent a pound for the starch that his corn contains. They will, and they should, continue to insist that if farm crops are to be used in industry the farmer should receive his fair share of any profits which may accrue, and they will further insist that when the farmer buys back his own industrially treated product he still be permitted to make a profit on the transaction.

With the welfare of the farmer clearly in mind and with a desire to be of benefit to society as a whole, the Minnesota Experiment Station is deeply interested in developing increased use of farm products in industry. It is fully aware of the fact that the greater the diversity of uses to which agricultural products can be put and the greater the number of outlets for the products of the farm, the greater the possibilities for profitable farm operation. I would be very happy, indeed, if we were to have an adequately financed group in the station whose sole responsibility would be to explore into the possibilities of making profitable use of farm products in industry. This group would need to be blessed not only with the genius of scientific discovery, but also with sane and tempered judgment, which can be arrived at only by having an intimate knowledge of economic conditions and trends. In view of the tremendously wide range of desires for all manner of products and articles, I realize how agricultural production is handicapped by being limited primarily to the market for food, clothing, and shelter. The late Professor Eckles repeatedly called my attention to the fact that the dairy

cow is an economic asset chiefly through the human food she provides in the form of milk products and meat. To him the great quantities of skimmilk not used in Minnesota for any purpose amounted to an appalling waste which should be headed off. Cow's milk can be converted into many commercial products, but the processes of conversion need refinement in order that these products may come within the range of profit to the farmer at a price the consumer can and is willing to pay. Here is a case, and there are many others similar to it, in which chemists and other scientific workers need to join in their researches with the economists to make the dairy cow a still greater economical asset to the farmer and a still greater benefactor to society. No other group of research workers is as well qualified to go into the possibilities of agriculture in serving the needs of industry and at the same time develop these possibilities for the benefit of agriculture as experiment station workers. My sincere hope is that a way can be provided for greater effort along this line. (Lest my comments on milk products be misunderstood, I would call your attention to the fact that attempts to make industrial uses of them have not been unfruitful. A visit to Land O' Lakes or Twin City Milk plants will fully convince you of this.)

Home economics.—When the Purnell Act was passed in 1925 providing additional federal funds in the states for research, specific mention was made of home economics, rural sociology, and economics as fields in which the funds could be expended. Up to that time, home economics had not had much to invest in research. During the last 10 years valuable researches have been organized and it is apparent that various home problems, such as selection and preparation of food, textiles, human nutrition, child care and training, and general household management need the aid of research.

Rural sociology.—Rural sociology is concerned primarily with the social actions and social needs of farm people. Rural society at present is in a state of readjustment and readaptation to changed economic and technological conditions, and hence should be in position to take advantage of social planning now dominant in the minds of national leaders. If oncoming changes result in what we conceive to be progress, an advance toward the goal of human happiness and what we like to call the ideal American level of living, changes must proceed on the basis of sound, adequately tested facts rather than mere impression or opinion. As we improve the scientific techniques which result in more efficient ways of making a living, there is need for more scientific study of the social problems of farm people having to do with the "art" of living.

Some of the aspects of our rural life which are in immediate need of scientific study are as follows:

1. What is the new plane of rural living following the depression

and the drouth? What are the changes and retrenchments in farm family and community standards of living? What items, such as expenditures for health, education, and recreation, have been most affected by the depression? It is possible that farm families have an accepted optimum standard of living to which they tenaciously hold, and below which they cannot be long held without dangerous social reactions. What are the implications of these changed ways of living for public agencies and social institutions such as schools, the church, and social welfare facilities?

2. The number of farms in Minnesota has been increased by over 10 per cent since 1930. All except three counties, Chippewa, Martin, and Wabasha, in the state, report a gain in number of farms. This is a general national trend. Many of these new farms are part-time enterprises. There is a need for a study of the part-time farm to see whether its economy is subsistence or subsidy, to discover what are the social implications of this rapid growth for rural and urban society.

3. American people are constantly migrating. The farm to city migration has been looked upon as a major problem; during the depression we have seen a great back-to-the-land movement. But nearly every year during the last fifteen, at the same time that one to two million people were leaving our farms for the city, almost as many were leaving the city to go out on farms. This whole question of migration between farm and city is largely an unexplored field and needs continuous investigation. An analysis of these migrants by age, sex, occupation, and if possible, financial and social status, would help to give insight into the favorable and unfavorable circumstances of rural life.

4. Tenancy is steadily increasing. In Minnesota, in 1930, 31.1 per cent of all farms were tenant-operated. There is a high turnover of tenants in frequently changing farms. What are the implications of this increase in instability from the standpoint of the tenant family and from the view of the community's social life and social services?

5. We commonly speak of submarginal areas, using economic criteria as the basis of submarginality. It is possible that we should define submarginal in terms of social criteria as well as economic. Research is needed to discover what constitutes a submarginal area from the social point of view.

6. The field of rural social institutions and rural social organization is a fertile field for research. The problems revolving around rural education, for example, are important for the future. Farm areas have a small proportion of their number in the producing age group and have less wealth and a smaller income than the urban population, yet are called upon to bear the cost of more dependents. For example, in Minnesota only 34.4 per cent of the urban population is in the age

group under 20, but for the rural farm population, 42.4 per cent are in the group under 20 which must be educated.

Religious, health, recreational institutions need to know the facts to adjust themselves to changed conditions. The most effective units of organization and administration and the possibilities of integrated and coordinated efforts have not been thoroly investigated.

7. Finally, the new field of rural social psychology is wholly unexplored in a scientific manner. What are the farmers' attitudes, his habits of thinking? What has been the effect of modern scientific agriculture on the personality of farmers? How has the depression influenced farmer opinion? Do the farmers think differently than urban people and how can we account for the difference in opinion? This problem has important consequences for social organization and community programs, and even for government.

Very briefly and in most sketchy manner I have touched upon some of the situations which indicate the need for experiment stations now. Generally speaking, the experiment station builds its program out of situations which arise and demand solution. As we get away from virgin soil and the simple life we must expect the problems of research to multiply rather than diminish. In the middle nineties of the last century, a prominent German scientist made his memory absurd by predicting that all of the significant scientific discoveries had been made. To make any such assertion today would be equally absurd. What next will be discovered in the realm of agricultural research no one knows, nor do we know how significant it will be. An experiment station, to be a great and potent force of stimulation and help to agriculture, should be staffed by highly trained workers who possess the spirit of research and the ability to pursue it. Their time should not necessarily be confined wholly to specific situations. Beginning with a specific situation, a research worker often comes upon a problem which seemingly has no connection with the particular situation in hand, but which greatly challenges his interest. In such cases, I say, let him pursue his interest at least for a reasonable distance. Great research ability and great results grow out of granting liberties of this nature.

If a planned program of agriculture is desirable, then a planned program of research properly moderated would seem feasible. Due to increasing complexity, no one division in an experiment station is qualified to attack a problem in all the phases calling for research. This being true, the attacks on problems should be carefully planned. Again, we are coming to a time when the economic and social implications of researches on given problems will need to be carefully evaluated. On this account, the social scientist as well as the biological scientist will

need to have some connection with researches which are primarily biological in nature. But I would turn the tables and say that the biological scientist should take a look at many of the researches that are primarily social or economic in nature. We are approaching a time when an experiment station to be most effective needs to have a planned, well-coordinated program in which all of the talent qualified to contribute to given problems is drawn together for concerted attack. I would not infer that we are not now engaged in building such a program. As you are aware, the Minnesota station is strong in the biological sciences, biochemistry, plant pathology, soils, agronomy, horticulture, animal husbandry, dairy husbandry, entomology, etc. These are older fields than farm management, economics, and sociology, in which we have developed a cherished degree of strength. In recent years, I have been gratified at the manner in which social factors have been recognized by those engaging in biological researches. This causes me to have great faith in the future of our research program for it indicates the degree of adaptability so essential in solving problems in which social and economic considerations must not be overlooked.

SEMI-CENTENNIAL DINNER

Friday Evening, June 14, 1935

Theme: Recognition Dinner Given for Vice-Director Andrew Boss

Presiding: W. C. Coffey, Dean and Director, University Department of Agriculture

Addresses

1. Research and Social Welfare, paper by Former Director A. F. Woods, read by Dean E. M. Freeman.

2. Recognition of the Work of Andrew Boss, A. J. Glover, Editor, Hoard's Dairyman, Fort Atkinson, Wisconsin.

3. Response, Andrew Boss.

4. Research the Road to Knowledge, R. H. Newton, Director National Research Council of Canada, Ottawa, Canada.

At the conclusion of the dinner a set of Walter Hagen matched golf clubs and a handsome steel casting rod and reel were presented to Dr. Boss by Dr. O. B. Jesness speaking on behalf of friends and associates contributing. A fund was also established in support of an Andrew Boss Library to be maintained at University Farm.

RESEARCH AND SOCIAL WELFARE

A. F. Woods, Former Dean and Director, Minnesota Agricultural Experiment Station

Friends and members of the staff of the Agricultural Experiment Station of the University of Minnesota.

I am glad to be with you in spirit if not in person on your fiftieth anniversary, to present my greetings and best wishes for your continued success.

Research institutions in general during the years of this depression have been the object of considerable criticism as the agencies whose discoveries have been the indirect cause of too rapid industrial expansion, resulting in the substitution of machines for human labor and the development of mass production methods, allegedly leading to permanent unemployment. President Compton efficiently punctured this bubble by showing in a brief paper published in Science some months ago that for every job displaced by machines several new ones had been created. The principal cause of trouble resulting from mechanization of industry is the difficulty of shifting men from one type of employment to another. Industry and society as a whole have neglected to provide adequately for this social readjustment necessitated by advances in the technique of living under changing conditions. The Bishop of Ripon has voiced the criticism of the situation thus created in his proposal that the scientists of the world take a ten-year vacation in research effort while the world adjusts its affairs to the knowledge at present available. In this surface view of the situation the Bishop has been taken quite seriously, though it is difficult to think that he intended to do more than call attention to the fact that sociology, economics, and political science, as represented in social action, were far behind in devising effective methods of making wise and equitable use of the knowledge and power gained through science and invention. This indictment of the social scientists will be generally admitted as true.

Secretary Wallace has emphasized the idea that the social use of discovery and invention should not be neglected by scientists and that research should be broadened to include the social problems raised by new discovery. He urges that research effort in general be increased, not lessened.

This has been and is today the attitude of those who have directed the policy of the experiment stations, the Land Grant Colleges, and the Federal Department of Agriculture from their foundation. It is clearly

expressed in the organic acts establishing these agencies and in subsequent acts enlarging their powers. The present effort to crystalize a more catholic, unselfish, and cooperative social public attitude is largely the result of the planning and work of these institutions and agencies. The men and women that they have trained, the organizations that they have been responsible for setting up, and the results of their research are the dependable agencies in finding the way out of such difficulties as now beset the world. For specific detail in support of this declaration, read the Report of the Land Grant College Survey conducted by the U. S. Bureau of Education; the addresses published in the Proceedings of the Association of Land Grant Colleges and Universities; the Experiment Station Record; the Journal of Agricultural Research; the bulletins of the Federal Department of Agriculture and the State Experiment Stations; the reports of the Cooperative Agricultural Extension Work, including the Boys' and Girls' 4-H Clubs, and the Cooperative Vocational Education work conducted in the high schools under the direction of the U. S. Bureau of Education and the State Departments of Education. These agencies, with the agricultural press and to an increasing extent the city press and more recently the radio, have for many years cooperated in making it possible for the people generally to have all the facts relative to important problems affecting their welfare available for consideration to guide them in choosing the paths that lead to higher and better levels of living.

For fifty years the Agricultural Experiment Station of the University of Minnesota has taken an active and constructive part in this great program. Here research in plant breeding, animal nutrition, agricultural and soil chemistry, farm management, and agricultural economics were first emphasized and developed in an effective way.

The University of Minnesota was also the first to recognize the need for two types of education in agriculture: (1) The training of men and women for research and educational work, and (2), as represented in the University schools of agriculture, the training of men and women for country life and farming.

Both types of education have been and are today thorough and effective, with their specific objectives kept constantly in view. Both are becoming more clearly appreciated not only in Minnesota but in many other states and in foreign countries. Throughout this development there has been evident a constant open-mindedness and social vision, and desire to improve facilities to meet changing conditions and demands. There is here in the University of Minnesota a fine spirit of cooperation with other agencies. The business men of the state have realized the fundamental importance of agriculture and agricultural education and research and have been and are today among the most ardent

supporters of these types of social service. During the years from 1910 to 1917 when I was dean and director here, I invariably found the business men effective champions of our efforts to improve agriculture and the agencies promoting better life on the farm. The same may be said of the agricultural press and the press in general of the Twin Cities. This understanding and helpful cooperation is the only way out of our present difficulties.

Where are we going from here? I believe that we shall move forward to still greater accomplishments in building on the foundations already laid to a better state and a better nation. We shall not do it by revolution but by evolution. We shall go on with our research and discovery and its application to better living. We shall use more machinery and more power and save time for more recreation and enjoyment. We shall still further reduce the cost of living by reducing costs of manufacture, production, and distribution. We will develop our lakes and parks, our forests, streams, and highways leading to them. We will control the run-off from rainfall, prevent erosion, protect our streams, prevent floods, restore our lakes, develop wild life and improve hunting and fishing, thus enlarging the field of outdoor enjoyment and profit. We will reforest much of the area adapted to the growth of timber crops. A stabilized lumber industry will take the place of the destructive program of the past. Our best agricultural lands will be protected and developed, utilizing the improved varieties of crop plants developed at our experiment stations and using the improved methods demonstrated there to be most effective. Thus, with thought and planning and effective cooperation, we shall eventually accomplish the realization of our objective—a better scale of living as widely distributed as possible, freedom from the fear of war, famine, pestilence, and slavery, opportunity to work as free men and women, leisure to enjoy the fruits of our labor, and opportunity to promote goodness, beauty, and truth.

DR. ANDREW BOSS

By A. J. Glover, Editor, Hoard's Dairyman, Fort Atkinson, Wis.

It is a source of great satisfaction to me to be given opportunity to participate in the program commemorating the fiftieth anniversary of the Minnesota Agricultural Experiment Station and help honor my lifelong friend, Andrew Boss. It has been generally recognized that Dr. Boss has been the keystone of the arch in this institution for many years and that the time he spent here nearly spans the life of the

Minnesota Experiment Station. The enviable position he holds was not gained through political pull, but because he possessed the qualifications and characteristics essential in research and educational work. He has had a comprehensive understanding of the farmer's problems and the farmer. His background of preparation for the important task he has assumed has been more substantial than can be gained by simply going to college.

Dr. Boss did not have a college education. Some people have considered this a great handicap. The Board of Regents, as well as some of the presidents of this institution, wondered if they were justified in advancing a man without a college degree to the most responsible position in the experiment station. It has been a source of satisfaction to all these men and to his many close friends and associates that no matter what he was given to do, he discharged his duties well, and he has shown unusual talent in the character of work done in an experiment station.

Formal education gathered from textbooks through capable teachers is a valuable asset to the man who has intelligence enough to use it. But to hold that a college degree is essential for a successful director of research or a great teacher ignores the contributions great men with no more than a common school education have made to society. Schooling is essential to all human progress, but it is not the alpha and omega of success. A person must be capable of being trained if training is to become an important factor in his life. It is a mistake to think that a formal education will help all people. Whether it would have made Dr. Boss a more useful servant to his state and to his students may well be questioned, for he possesses natural talent that made him unusually well qualified for the many tasks imposed upon him for more than forty-five years. This does not mean that he has not been educated.

I know the schooling Dr. Boss received perhaps better than any one here. It was severe and exacting. He was blessed with an exceptional mother, intellectual, kind, and industrious. His father was a man with a keen mind, a student of good literature, and possessed high moral standards. He trained his children carefully and demanded a standard of conduct which at times seemed severe. This is the rich heritage of him whom we are honoring tonight. His environment was a farm in Wabasha County and in his home he was in contact with high standards of living and good business practices. The literature he read was the best and carefully selected. There dwelt in his pioneer home the elements essential to the building of character and a well-balanced understanding. All these things, coupled with the work of a well-managed farm, gave a training no university can provide. It can only supplement such schooling.

It is not my purpose to belittle the importance of educational institutions but to account, to some degree at least, for the reasons why Dr. Boss has been so successful in the work he has done here. His home was a university and his training was adequate for the many positions he has filled in this experiment station. The results of his work conclusively prove this. He is a natural judge of evidence, which is very important in evaluating the results in research work. This trait is lacking in many research workers, and no schooling can provide it. Education may help to develop and strengthen and sharpen the ability to judge evidence, but a person must have some inborn trait of this character before polish can be given it in a college. Dr. Boss understands human nature, which is no mean asset in an institution of this character. He is by inheritance a good farmer, which means he has the ability to master many activities and coordinate his work.

I am informed that he is an exceptionally good fisherman, hunter, and golfer. As long as I have known him, I have never fished or hunted with him. I can say nothing about his proclivities for these two sports or how well he is adapted to them. As a golfer, I have measured sticks with him several times and find that he is typical of his race. He is very slow to take divots with his strokes and if his opponent drives the ball into the water pool, you can see his Scotch ancestry rippling all over his face.

He has another weakness, if golf may be called that, which no one here wrote me about. Perhaps none of you know about it, but blood will express itself. It is my candid opinion, friends, if a kiltie band came down the avenue this moment and he could hear the skirl of the bagpipes, he would leave this splendid occasion and march away with the kilties. He is a Scotchman, and the sound of the bagpipe calls more forcefully upon his nature than any program instituted by his friends to recognize his services.

It is both fitting and wise that the service rendered by Dr. Andrew Boss should be recognized at the fiftieth anniversary of the Minnesota Experiment Station. He has grown with the institution. He was first farm foreman and through gradual advancement has been vice director for many years. In the several positions he has held, he has familiarized himself with the work of more departments, perhaps, than any man engaged in research work. He fitted well in all of them. When he became assistant agriculturist, his farm experience and the several years in the position of farm foreman provided a foundation which has served him well, even though he did wear a derby when sowing grain by hand. He was perhaps the only member of the staff who had the art of distributing grain evenly on the field by hand.

Dr. Boss established, I believe, the first college abbatoir in the United States. This gave him opportunity to exercise his talent for getting at facts. He studied the beef animal not only externally, but he got under the hide where the real value of a meat animal may be measured. Appearance may be pleasing to the eye, but it does not necessarily provide the best roast of beef or develop the most economical producer of beef. In one demonstration he saw a steer slaughtered that had received third place at the International Exposition in Chicago. The steer was too fat to have all his carcass excellent beef. When he was returned here, Dr. Boss took occasion to drive home the lesson that beef could be over-finished and he sent the plate meat of this animal to Miss Sheperd, in charge of the culinary department of the School of Agriculture. She promptly returned it. He had quietly but effectively demonstrated his point. This incident clearly shows that he comprehended the spirit and purpose of the experiment station and the reason why the tax-payer is asked to support it.

Shortly after this demonstration he made another one and this, I believe, was in cooperation with Prof. T. L. Haecker, then chief of the Dairy Division. A seven-eighths Holstein steer was raised by the Dairy Division and taken to the International Exposition in Chicago. This steer did not fare well before the judges when alive because he was not of royal beef blood. His black and white covering showed poor breeding for meat production and in the estimation of the judges. When his hide was removed he received third prize in the block test, the place where beef merit was appraised without prejudice. These two incidents illustrate that Dr. Boss had not only the initiative to search for truth, but the courage to carry on experiments that would find the facts even though they might be objectionable to some people.

Preconceived notions and prejudices are strong human traits. When truth appears to dethrone them, it is often received with derision. The nature of Dr. Boss is such that he does not become unduly depressed by criticism or too enthusiastic about success. When he had a job to do he did it. His purpose was not to prove some notions wrong, but rather to find the truth. To his mind the experiment station is an institution to find facts and present them as found. It is unfortunate if research dispels some beautiful theories held by prominent agriculturists and farmers, but why have an institution sustained by taxes if effort is not directed to finding the facts concerning every branch of agriculture. This trait of character has brought Dr. Boss the confidence of all the people who know him, has made him a leader among farmers, and has given a dependable counselor to the experiment station staff and the university faculty.

Dr. Boss was one of the first to see the necessity for farm manage-

ment studies in experiment station work and to teach this subject in college. He was one of the first to write a book on this subject. His keen appreciation of what constitutes good farm management led him to give more than passing attention to this important subject. He comprehended that the agronomist was discovering new information on how to grow better crops; the animal husbandman, on how to grow better livestock; in fact, each division of the experiment station was finding new and useful information for the farmer. The rural economist was pointing out the advantages of neighbors cooperating in the sale of their livestock and crops. He had observed what had been accomplished by farmers under the leadership of Prof. T. L. Haecker in establishing cooperative creameries and cheese factories for the purpose of processing their milk. He knew from his boyhood experience that the good farmer must be able to coordinate his work, to select such crops as are best adapted to his soil and market.

ANDREW BOSS

To be a good farmer, it is not enough for a man to have a high-producing dairy herd, a well-bred beef herd, or to grow excellent crops of corn. There is a balance that must be considered for every farm if the right kinds of feeds are to be produced in the right proportions. Certain crops may be grown at a loss and yet yield a profit because in growing them there is a better distribution of labor and a better utilization of land. Handling the soil, growing crops, rearing livestock, and cooperating with neighbors requires special study that these things may be harmonized and coordinated in such a way as to bring the best returns to the farm and develop the best farm communities.

I know of no one better qualified by his natural talents and training to discuss a subject of this character than our good friend, Dr. Boss. Before we can deal wisely with any subject we must have adequate facts. This places a large responsibility on the experiment station. It shows clearly its reason for existence. It seems to me it has an even larger duty to perform than simply supplying the farmer with information on how to grow crops, rear livestock, and care for the soil. It should assist him in utilizing his land to the best advantage. This means wise

selection of crops to be grown and a proper coordination of farm work. It is my belief, knowing our honored guest as I do, that he received more enjoyment from doing this character of work than in directing research, or holding demonstrations in meat production, or judging a class of livestock. This is another trait that has made him so important in this experiment station which is seeking information to aid the farmers of the state and helping to interpret its research work that the practical farmer may use it advantageously.

When Dr. Boss and I were boys living in the same community, the chinch bug got the best of the farmer. It all but ruined the agriculture of our county. This little pest, which for a time defeated many farmers, was really the beginning of a better system of agriculture in Wabasha County. It meant that they needed more information and men to interpret this information. The early pioneer exercised a lot of ingenuity in building his home and other farm buildings and subduing his land. He faced hardship resolutely and won. He continued growing wheat until it was no longer profitable, and when he turned to livestock farming, he found this more complicated. He was in need of more information. Wheat raising is a simple, delightful occupation in a new country, but it takes only a few years before insects come and soil conditions, weeds, and other things make this single crop system unprofitable. While the farmer is an individualist, and will perhaps always remain so, new conditions and progress have made it necessary for him to have others cooperate in bringing about new practices in agriculture that he may succeed and be able to meet the ever-changing conditions of the world.

The Minnesota Experiment Station was fortunate in having a man with Dr. Boss's training, for with his understanding he was able to direct research and present it in such a way that it would be of greatest help to the man living on the land. It is no mere accident that he has served so well, because he knew the conditions on the farm and with his vision could direct himself intelligently to unfolding new facts that would help to bring larger returns to the farmer.

As vice director of the experiment station, Dr. Boss has achieved many things. There has been no drastic reorganization, but he has brought the institution forces together in a good cooperative program of research. Minnesota stands high in the estimation of all other experiment stations. He has had that power, vision, and understanding that is essential to creating the kind of organization necessary to carry on research effectively. He has always directed himself to cooperation through gentle persuasion, rather than engaging in what might be termed drastic reorganization or force. He has done a masterful job by this method and, as a result, secured cooperation without destroying the individual initiative that is so priceless in research work.

Dr. Boss has been a great stabilizer in this organization. It is well known that in all institutions of this character there are many minds. Conflict and jealousy arise, and these have to be dealt with. Dr. Boss, having a keen understanding of human nature, has met the various human problems quietly but forcefully. It is a high compliment for any man after so long a service to have the abiding respect of all who know him and work with him. No one on the campus is stronger in leadership than Dr. Boss, and this has been brought about because he has directed himself intelligently and has had an honest desire to secure facts that will help to build a better agriculture in Minnesota. These splendid traits have made him a reliable leader and have given him the vision to be a wise counselor in every department of the Minnesota Experiment Station.

Here is a bit of his philosophy about the farm and what it necessary to win success and some of his advice to those who are considering farming as an occupation:

1. "Get a good husband or wife. I put this first.
2. "Find out for sure whether you want to farm. If in doubt, rent a farm before buying.
3. "If you don't have the knack of making right decisions more than half the time, better work for somebody else.
4. "If you buy a farm pay at least 25 per cent down and have the rest on a long-time, low-rate mortgage on which you have to pay part of the principal each year.
5. "Be wary of heavy debt.
6. "Organize your farm business so that you will have a pay day at least once a month.
7. "Don't overlook the 'living' side of farming as you go along. It is easy to forget what the whole game is about."

Andrew Boss was born June 3, 1867, on a farm in Wabasha County, Minnesota. He attended the rural school and entered the Minnesota School of Agriculture in the fall of 1889, graduating in the spring of 1891. He was appointed foreman at the University Farm, May 1, 1891, and served in that capacity until 1894 when he was made assistant agriculturist. In 1902 he was advanced to associate professor in agriculture. From 1905 to 1909 he served as chief of two divisions, agriculture and animal husbandry. In 1910 he was granted full professorship and made chief of the Division of Agronomy, Farm Management, and Plant Genetics. In 1918 he was appointed vice director of the Experiment Station, but he served as chief of the Division of Agronomy, Farm Management, and Plant Genetics until it was reorganized in 1928. Since 1928 he has devoted most of his time to the Experiment Station but has continued to teach his former classes in the

new division. In 1933 he was appointed director of the production control program in Minnesota for the Agricultural Adjustment Administration. He still holds this position. The past year he was appointed director-at-large of the Farm Credit Administration of the Seventh District.

Professor Boss has taught classes in the School and College of Agriculture and in the graduate school since 1894. He has been continuously in the service of the institution, except for three months in 1926 when he had leave of absence to reorganize research work in the Farm Management Division of the Bureau of Agricultural Economics, U. S. Department of Agriculture. His teaching and research work have covered three distinct fields of agriculture: economics, agronomy, and animal husbandry, and his administrative work included the entire Experiment Station.

The splendid service which he has rendered to agriculture in this state, to the school, University, and Experiment Station caused the Kansas State College of Agriculture in 1927 to honor him with the degree of Doctor of Science. He is a fellow of the A.A.A.S., a member of Sigma Xi and president of the Minnesota chapter in 1934-35, a charter member of the Honor Society of Agriculture, Gamma Sigma Delta, and an honorary member of Alpha Zeta. He is a member of the American Farm Economics Association and served as president in 1915. He is chairman of the Experiment Station Section of the Association of Land Grant Colleges and Universities for the current year. He has been a member of the Minnesota Livestock Breeders' Association since its organization and served as its secretary from 1902 to 1912. He served as secretary of the Minnesota Crop Improvement Association for seven years.

Professor Boss is author of the book, "Farm Management," and of many bulletins. One of his large services to the farmers of the state has been in the articles he has prepared for the agricultural press. He has also responded generously to heavy demands on his services as a speaker at scientific meetings, farmers' organizations, and farm gatherings of all kinds. He has answered thousands of inquiries from farmers throughout the state and scientific workers throughout the world.

In addition to all this, he has found time to take an active part in religious activities and community affairs. What he has done for the church, the Y.M.C.A., and in community affairs again emphasizes that he is by temperament an excellent farmer, for he not only manages his own affairs well but finds time to help make the community a better place in which to live.

RECOGNITION DINNER HONORING DR. ANDREW BOSS

Response by Dr. Boss

Dean Coffey and Friends: I think I must include you all under that term. I see so many different groups represented here that it would be impossible to mention each separately and on my part I am only too glad to include you all as friends. It is difficult indeed to find an adequate response to such an introduction. Since reference has been made to my Scotch ancestry and the bagpipes, I must confess that while Mr. Glover and Dr. Jesness have been speaking, the words of Burns have been running through my mind. The particular words that I refer to are these:

"O wad some Power the giftie gie us
To see oursels as ithers see us!"

I only hope that your vision has not been distorted by kindness, and I know that those who have spoken usually mean what they say.

The only credit I can claim is for coming into the world at the right time to be of useful age when I, by accident, in 1889, fell upon the then just developing School of Agriculture and, the next spring, upon the Experiment Station, also in its extreme youth, so that we could grow up together. This proved to me a Pandora's box out of which ideas that interested me greatly were just starting to come.

Perhaps I should make claim also to enough intelligence to know a good thing when I saw it. To prove this, you have only to consider the persistence with which I have stuck to the Station. If that is not proof enough, just look at the wife I picked and the fine family we together have raised and collected (by marriage).

Since my colleagues have insisted on paying tribute to what they say I have contributed to the Station, to the University, and to the State, it is only proper that I too be allowed to give my version of the story.

I came into the world amid humble circumstances, but of good Scotch stock who knew well the value of industry and thrift. I was one of a family of nine children raised on a southern Minnesota farm in the years of the depression following the Civil War. Under such parentage and environment I soon learned that it was necessary to work and to *give* as well as to *get*.

It may not be out of place to remind you that the College of Agriculture and the first University experimental farm came into existence at approximately the same time that I did and grew up under much the

same stern necessity for thrift and strict economy. Thus, I had much in common with the University, so far as background and experience count, when the eventful 1885, or to me the more eventful 1889, arrived.

The pathway of agricultural education and research from 1858 to 1885 is scar-marked from many a battle with political strife and financial adversity. Those schooled in such agricultural science courses as existed in those times knew well the stringency of the times and the need of much service to agriculture for meager financial reward.

Such was the environment out of which I came. Such was the environment out of which was hammered the School and College of Agriculture, and the Experiment Station. Such, also, was the environment out of which came that little band of inspired and consecrated men and one woman collected together by Professor Porter to serve as the first faculty of the School and Staff of the Experiment Station. Out of such an environment only could have been born an institution so completely dedicated to service and to the welfare of humanity. And, I am happy to say the vision and impress of that environment, of that faculty, and of that staff have not yet passed from the institution. I, for one, hope that it never will.

If, as you say, I have contributed to the reputation and welfare of the Station, it is only because of my early lessons in work and service and my good fortune in being thrown into association with patient, kind-hearted teachers and scientists who were willing to help a green, gawky country boy grow up.

Crawling under the flap of the tent in which this now really great University is housed, as I did, I can hardly realize that it has taken me 46 years to find the exit, which speaks well for the patience of the staff and of the University administrators, if not for their wisdom and judgment. Most young men find the exit in one to four or five years.

Why did it take so long? Just because I refused to take a degree and get out. By birth and by early experience I am a nature lover. The beauty of the architecture of all of the new buildings (except Pendergast Hall) then just completed, enthralled me; the mysteries of the New Orleans Room where were stored the remnants of exhibits of plants returned from the exposition where Professor Porter had shown them, enticed me on rainy days; the flocks and herds containing breeds I had never seen before excited my curiosity; the landscaping and gardens and test plots were ever-stimulating exhibits that won my interest and eventually my heart. Why not stay and enjoy it? I did.

I found in the Experiment Station work answers to many of the questions I had long pondered. There was also the opportunity to raise new questions or have them raised, and the delight of finding the

answers. I had also, in time, the privilege of serving as instructor to boys and girls in the S.A.U.M. and, in turn, to help them grow and find themselves. Nor less satisfying was the privilege of carrying messages to farmers, by voice, pen or published word, which I hoped and believed might lighten their burdens or increase their satisfactions. Since October 18, 1889, I have been in love and full sympathy with my job and my surroundings. If I have worked hard, as some seem to think, it was only for the joy I found in it and the enthusiasm born from the belief that I was doing something useful and worth while. I have had full pay for my work in comfort and satisfaction as I went along. Whatever else comes now is of little matter, though naturally I do cherish, more than I can tell, the thought that my name may be added to the list of those who have served well.

During all of these years the University has been kind to me. The directors of the Station, and I have known intimately and worked closely with all of them except Director Porter, have overlooked my mistakes and tolerated my advice, even professing at times to think it good, whether or not they used it. Salary matters have never been discussed with me. This strange fact I attribute to a bit of advice given me by my father when I asked his permission to take my first full-time job with the University. He said, "Now, Andrew, make yourself so useful to them that they can not get along without you. No matter what they pay you, try to earn a little more than you get and they'll raise your wages." And they did just that. Approximately every two years for a period of thirty-five years, without suggestion from me, my salary has been raised to a point where I have had to work my head off to earn it, so I would get a little more. If I had gained any idea during all that time that I merited such distinction as you have insisted in thrusting upon me tonight, I might long ago have let down on work and drifted along on my reputation. That reminds me of a story that I may tell on one of the early directors whose mother kept house for him. He was a somewhat pompous, blustering kind of a gentleman, who professed great industry and expressed it by pernicious physical and vocal activity. My wife one day admitted to his mother her surprise at the director's bustling around so energetically at 4:30 and 5:00 o'clock in the morning. "Oh, you see," his mother said, "he is making his reputation now. When he gets it made, he can lie abed until noon." If you catch me lying abed until noon now, you will know it is because you have certified that my reputation is made.

Ever since May 1, 1891, when I became foreman of the Experiment Station farm, I have been responsible for more work than could be done by one man. Since 1902, when I took official charge of the

animal husbandry division, I have had associated with me many able young men who have helped generously in making my reputation while getting opportunities to make their own. One of my greatest satisfactions has been to see these former students and associates gain national and international recognition as scientists, educators, or administrators.

I look back and around me with pleasure and satisfaction at the happy relations established with my colleagues in the work. Where jealousy and strife might easily have crept in, there has been in the main only friendly assistance and helpful advice; many of them have been big brothers to me in more than a professional way. My only way of compensating them for this was to be a big brother to some one else who needed one. Most of those who have helped me desired nothing more.

I must acknowledge also the most loyal support I have had from the two directors whose worst "Vice" and at the same time whose best "Vice" I have been, as up to this time there has been no other. No small factor in any contributions I have made to the Station is the opportunity and encouragement given me by them. These large-hearted, keen-minded, far-seeing agricultural statesmen have been both most charitable of my shortcomings and generous of credit for the little I have accomplished. Two kindlier, finer spirited associates would be difficult indeed to find. I must express also my appreciation of their ability to keep me in good standing with the presidents of the University and the Board of Regents. Because of their kindness, my official life has been happy indeed.

Finally, let me say that I believe much of the success of the Minnesota Experiment Station is due to the fact that it is born out of the cries for help coming out of the grass roots, and manned by those coming from the farm environment in full acquaintance and sympathy with the needs of farm people. Throughout the half century whose turn was marked on March 7, 1935, the Station, through its staff, has kept closely in touch with farmers and farm problems. As science has advanced, and it has by leaps and bounds, the findings have been prepared and presented in such a way as to be gradually accepted and applied by farmers in improving the quality of their farm business and standards of life. If the Station is to succeed further, it must continue to light the pathway of knowledge for those who farm. The scientist must talk to farmers in the language of the farm. To be sure, the farmer's vocabulary now includes some of the words of the scientist, but he is still a farmer, though much better versed in science than those of fifty years ago. Why do I say this? Because I think I have detected

a growing tendency for scientists to talk to scientists and to write for them; to think of the science without the farm. This is permissible, even desirable at times, but the Station's findings must still be presented to the constituency whose needs gave it birth, with full knowledge of, interest in, and understanding of farm life and farm problems. These words of warning are probably unnecessary. The Station is in capable hands, with a staff second to none in the land. Under the guidance of Director Coffey, who refuses to lie abed until noon, though his reputation is made, the farmer's interests are safe and the scientists are assured of sympathetic support. Long may the director serve and the farmer prosper, for then shall the scientists find nurture for their souls.

Had I known the ways of science and of scientists as well fifty years ago, or even twenty-five years, how much more I might have accomplished. Knowledge comes slowly, however, even within the confines of a great University, and comparatively little progress has been made as measured by what might have been. As I look back, I can only say with Gilmore, the poet, "So little done, so much to do!"

And now, in appreciation beyond my power to express in words, let me thank you all and say to my colleagues I shall probably serve the Station better for the next year on three-fourths time than I have during the past two years on full time.

RESEARCH, THE ROAD TO KNOWLEDGE

R. Newton, Director, National Research Council of Canada, Ottawa, Canada

Man is born with a natural curiosity and a spirit of adventure, which impel him along many new roads. Under the impulsion of these inborn forces Leif Eriksson and Christopher Columbus sailed into the unknown West to discover new worlds in earlier times, and Colonel Lindbergh and Admiral Byrd, with the same spirit but better equipment, have conquered still newer worlds in our own time. These men are types of the army of explorers, or researchers, who are pushing the boundaries of knowledge farther and farther in all directions. The attainment of the objectives nearer at hand stimulates an advance upon those more remote or inaccessible. Now, with the aid of giant telescopes we plumb the vast depths of the universe, and with the aid of giant electron tubes we pry into the sub-microscopic interiors of atoms. The road to knowledge projects itself to infinity, not only in distance but in the variety of its branches.

One striking characteristic of research as we know it today, which it shares with modern civilization as a whole, is its rapidly accelerating pace. While members of the zoological tribe Hominidae, to which man belongs, have inhabited the earth for perhaps a million years or more, the beginnings of civilization in our modern sense do not go back more than eight to ten thousand years, when the development of agriculture, beginning perhaps in the valleys of the Nile or the Euphrates, for the first time provided a dependable food supply for any considerable population. The beginnings of science in our sense of the word came much later. Individual geniuses, possessing a scientific outlook, had appeared among the Greeks in the late centuries before Christ, and in the 13th Century of our own era Roger Bacon, the *Doctor mirabilis,* set out clearly the great advantages of experimental science over the speculative theory which had been the chief preoccupation of classical philosophy. But it was not until the 16th Century that science based on experiment and inductive reasoning really began, ushered in by that prodigy of nature, Leonardo da Vinci. Since then science has advanced in geometrical progression, with corresponding effects upon the material aspects of civilization.

A. N. Whitehead, who, it may be remarked in passing, represents one of England's greatest intellectual gifts to America, has described very graphically the shortening time-span in human affairs. He contrasts with changes such as the substitution of bronze for flint and of iron for bronze, which involved periods of a thousand years or so, the rapidity with which changes crowd upon us in this age. He regards the two centuries between the invention of printing, about 1450, to the foundation of the Royal Society of London, in 1660, the hundred and forty years from then to the close of the 18th Century, the first ninety years of the 19th century and the last forty years or so as a series of diminishing time-spans of approximately equal material advance. One serious consequence of this accelerating progress is the strain it puts upon the economic and social fabric of our civilization to keep pace with the change in its material structure, a strain which obviously it has not borne any too well.

It is of interest to consider some possible causes of this acceleration in science and its accompanying material development. A colleague of mine in the National Research Laboratories of Canada, Mr. F. E. Lathe, gave us an address recently on "The Distribution of Scientific Knowledge." At the outset of his paper he asked the question, why during some hundreds of thousands of years man's progress was so slow, and why it has been so rapid during the last 8,000, particularly in the last century or two, and suggested that the answer was to be found largely

in the rate of development of facilities for the distribution of knowledge. The elaborate drawings found on the walls of caves occupied by Cromagnon man in France and Spain some 25,000 years ago, and commonly regarded as the beginnings of art, have associated with them hieroglyphics which we may probably regard as the beginnings of a written language. Until men learned to write, the facilities did not exist for the recording of knowledge and the transmission of that knowledge from one generation or from one country to another. It is probably no accident that the Renaissance of both science and culture took place shortly after the invention of movable-type printing, to which I have already referred. So far as can be judged by the cranial capacity of Cromagnon man, we have no grounds for supposing our individual mental endowment greater than his. But time has brought progressive revelation and unfoldment, and we are the inheritors of the accumulated knowledge and wisdom of the ages, mainly through the agency of the written word as it is preserved for us in our libraries. When we built our research laboratory in Ottawa, we provided space for a library of half a million volumes, which appropriately enough is located in the center of the building, as it must indeed be the heart of the institution. There are now more than a dozen libraries in the world with over a million volumes each, all playing their part as a primary tool in the advancement of knowledge.

The experimental method itself must be rated another prime cause of the acceleration of scientific development. It, too, was born with the general Renaissance in the 16th Century. The carrying out of experiments of course led to the development of laboratory facilities and equipment of ever-increasing refinement and complexity, which in turn made possible more and better experiments. The progress of research is a sort of autocatalytic reaction. We begin under the impulsion of ideas and the allurement of adventure. Each step discloses new prospects, exciting to the imagination, to explore which we press forward ever more eagerly, and ever better equipped by the experience which lies behind.

The professionalizing of knowledge, which has been so marked in this century, is another factor accelerating our progress. The limit of individual capacity to absorb and capitalize the rapidly accumulating sum total of knowledge is soon reached. The proportion by which any one of us may hope to extend the boundaries of the whole is in fact rapidly diminishing. But by dividing and subdividing the widening circle of knowledge into smaller and smaller sectors to be assigned to individuals, we seek to maintain the general rate of expansion of the whole. The dangers as well as the advantages of such a method are obvious, and it

need occasion no surprise that our circle has developed a serrated margin, not ministering uniformly to the comfortable progress of society. The well coordinated front which is so desirable is not always found.

To the original spring of research, the urge from within to discover new things, there has been added in increasing measure in this century the pressure of necessity. The increasing complexity of modern life created new wants which had to be filled by new invention, often based on research. Many of our wants have arisen as a result of changes in our mode of life and industry brought about by research itself—another manifestation of its autocatalytic nature. Then there was the tremendous pressure of the Great War. The National Research Councils of many countries were born of the necessity of the war. When the war ended in a military sense, it was followed by an economic war on a scale without parallel in history. There developed an almost world-wide policy of economic nationalism, in the supposed interests of self-containment and national security, featured by ever-mounting tariff walls, buttressed by subsidies, quotas, and similar expedients. Research was enlisted in the struggle to attain economic self-sufficiency with a minimum reduction in the standard of living. It is even now trying desperately to find new uses for surpluses no longer exportable, and to develop new products to replace those we formerly obtained by exchange with other countries.

In short, research has been drawn into the thick of the economic battle, and has made itself the indispensable ally of industry in the solution of its very practical problems. Times have changed since the president of the tribunal of the French revolutionists remarked, in 1793, as he condemned the great chemist Lavoisier to death, "The Republic has no need of men of science." The corresponding official of the greatest modern example of a revolutionary state only a month ago remarked in effect as he refused permission to Prof. Peter Kapitza to return to his low temperature researches in the Mond laboratory at Cambridge University, "The Republic needs all its men of science."

If we go back another century before the French Revolution, we realize that times have changed in another sense. The original motives of research have been all but lost sight of, as Professor More, of the University of Cincinnati, reminds us in the introduction to his recently published biography of Sir Isaac Newton. He states: "In this day of the utilitarian omnipotence of science, it is . . . difficult . . . to appreciate the conviction of Newton and his contemporaries that their purpose in the cultivation of science was to demonstrate the action of the divine will in the natural world, and not to contribute to our comfort, safety or power." Some few among our modern scientists, especially those

working in the domain of pure physics, have maintained the classical viewpoint in large measure, and in reading some of the more popular accounts of their work by men like Eddington and Jeans it is easy to recreate in our imagination the atmosphere of the 17th Century, the one century, as Whitehead remarks, "which consistently, and throughout the whole range of human activities, provided intellectual genius adequate for the greatness of its occasions."

The widening streams which have had their sources in the activities of individuals bear witness to the worth of the highest type of scientific men. Huxley said as long ago as 1877 that, "If the nation could purchase a potential Watt, or Davy, or Faraday, at the cost of a hundred thousand pounds down, he would be dirt cheap at the money." It was a modest estimate then, but how modest it would appear two generations later even Huxley little guessed, as he could scarcely foresee the enormous developments in steam engineering, industrial chemistry, and electrical engineering growing out of the discoveries of these three men.

By way of illustration, I shall venture to trace in a sketchy way one stream of thought and discovery of profound importance to agriculture, which in its origin owes most to the pioneer researches of two men, Darwin and Mendel.

It should be noted at the outset that these men were so-called pure scientists, that is, they were interested in gaining new knowledge for its own sake, and not for any economic advantage they foresaw from its possession. In their day they were regarded by many people as unpractical; they would be so regarded by the same kind of people today. The truth is that nearly every important advance in the field of applied science has been made possible by the pioneer researches of pure scientists. Without a steady flow of such contributions to our capital stock of new knowledge, applied science would speedily become bankrupt.

Charles Darwin, whose life covered the period 1809-1882, must be given chief credit for establishing the principle of organic evolution on a solid basis of carefully marshalled and analysed facts. Nearly all great generalizations have had a long developmental history, during which they have been darkly glimpsed from time to time by a succession of observers, until it was given to some master mind to see them fully and clearly, and set them forth in all their beauty and comprehensiveness. So philosophers and naturalists from Aristotle downwards had speculated on the idea of evolution, the last in the line, the great French zoologist, Lamarck, making important scientific contributions to the subject. The theory as Darwin finally developed it depends on the two principles, natural variation and natural selection; that is, in the struggle

for existence, those individuals possessing variations which adapt them better to their environment are more likely to survive. Whether this theory fits all the facts discovered by later investigators need not concern us here. The point is that it gave rise to a stream of thought which profoundly influenced human affairs.

In the physical universe there is no principle of more general applicability than evolution. While Darwin applied it only to biological organisms, and it does not lie within the scope of this paper to discuss cosmic evolution, the universality of the principle may well be borne in mind. Nor is there any generalization with more important philosophical implications. It might be pointed out that without the change implied in evolution there could be no hope of progress, and that the idea of progress carries with it the implication of a state of greater perfection towards which we are moving. The meandering of some man-controlled movements is no refutation of the idea of progress, but indicates only that we have not made the most of our opportunities. Atoms, molecules, and inanimate organisms in general move surely, according to fundamental law, which man-made systems too often disregard. There is, as poets, philosophers, and scientists unite to remind us, much wisdom to be gained by the contemplation of Nature. Whether we consider a plant society or a group of electrons, we find the two main factors in Darwin's hypothesis, namely, organism and environment, and we note that by combining in large numbers and working together the organism can influence its environment and improve its chances of survival.

The practical significance of Darwin's work will appear when we consider it in relation to that of Gregor Johann Mendel (1822-1884), who established the rules by which the variations, which are fundamental to Darwin's theory, are inherited. In his monastery garden at Brünn, Mendel crossed yellow peas with green peas, rough peas with smooth peas, tall peas with short peas, for the pure interest of seeing how these characters were inherited, with no thought of any practical gain. Yet out of his results came Mendel's law of inheritance, which is now the guiding principle of plant and animal breeders the world over.

Mendel's two papers were published in 1866 and 1869, in the Proceedings of the Natural History Society of Brünn, which unfortunately had only a local circulation, and it was not until 1900 that they were rediscovered and made generally known. They did not therefore influence Darwin's thinking, and their effect on evolutionary philosophy was much delayed. But once they did come to light, and the validity of Mendel's law was confirmed by many experiments with plants and

animals of various kinds, they became fruitful of results which are still multiplying.

Following upon Darwin's and Mendel's work, the species, which was previously regarded as a fixed entity, has become surprisingly plastic in the hands of man. Crossing, selection, and, most recently, modification of the environment, have all been used to change the character of species or even to develop new ones. In short, the evolution of those species of plants and animals which are of special importance to man has been brought under a large measure of control. The favorable variations occurring among species in Nature, which Darwin postulated as the basis of superior survival, are now produced to a considerable degree at will.

The practical importance of a measure of control over the evolution of domesticated plants and animals is self-evident. There are in evolution, as we have seen, the two factors, organism and environment, the success of the organism depending upon its adaptation to the environment. When we remember the devastation which drought has made in large areas of this continent for several years in succession, the widespread damage which untimely frosts have often caused, and the recurring epidemics of wheat rust and other diseases,—we are easily convinced of the value of better-adapted varieties. It is reassuring to know that plant breeders (including notably those of your own Station) are actively attacking the problem of producing earlier, frost-escaping, drought- and disease-resisting varieties.

The improvement of domesticated animals has lagged behind the improvement of plants, chiefly because of the much greater cost of breeding experiments with animals. A plant breeder can grow large numbers of specimens at small cost, and with greenhouse facilities can usually bring two generations to maturity in a year. Moreover, with self-fertilized crops, such as most of the common grain crops, the superior specimens located can be multiplied directly for further comparison and re-selection. Even with these advantages, the time which elapses from the making of the first crosses until a new plant variety, adequately tested, is ready for distribution to farmers, is rarely less and generally more than ten years. The animal breeder has often to deal with creatures requiring from one to three years to come to maturity. Then to avoid too close breeding, he must work with numbers large enough to ensure a reasonable chance of finding among the progeny of any particular cross a group of closely similar individuals with just the right combination of parental characters, which may be used as foundation stock for the new breed or type desired. The length of time which such an experiment is bound to require, and the cost of maintaining so many animals, have

acted as a serious deterrent to the improvement especially of the larger types of farm livestock.

Let me illustrate the problem by referring to the work of a committee on wool which the National Research Council of Canada set up to facilitate co-ordinated action by a number of institutions. This committee has arranged for some years now to have hundreds of fleeces from selected flocks carefully graded individually each year, both in Canada and England. Indeed, many of them were subjected to detailed laboratory study as well. The great lack of uniformity revealed, and frequent shortness of staple, are among the chief causes of the disadvantage Canadian wool suffers by comparison with the Australian product. A carefully selected lot made up into cloth seems to be giving good satisfaction. It has become clear, however, that no existing breed of sheep combines with the hardiness required on western Canadian ranges, the mutton qualities that are essential, and a satisfactory quality and yield of wool. The breeds surveyed by the committee during the last five years have been narrowed down to three, which among them appear to possess in a fair degree all the necessary characters. The next step is a breeding project with carefully selected individuals of these three breeds as parental stock. The number required to give reasonable assurance of success in a moderate time has been estimated at 1,000. The difficulty of getting that number of reasonably uniform and superior individuals, as well as the cost, may compel a start on a smaller scale, but then we must be prepared to wait proportionately longer for results.

The lag in the systematic improvement of farm animals as compared with farm crops is thus readily understood. The time has arrived, however, when this should be overcome. The advantages to be gained are more than sufficient to outweigh the cost of the enterprise.

So with the elegant tools placed in our hands by Darwin and Mendel we continue to fashion new forms, better suited to their purpose and to our needs. With their help the opportunity is ours to exert a measure of beneficent control over evolution which may greatly ameliorate the living and working conditions of the human race. Thus the works of these great pioneers do follow them.

Is the day of the pioneer over? We cannot answer, Yes, while we have figures like Einstein with us. Nevertheless, we now place much more dependence than we did formerly on organized, systematic research to ensure uninterrupted progress. Hence comes the enormous growth in our generation of state-supported institutions for research. Much of our energy is devoted to developing the implications of principles already discovered, a matter of filling in details or of applications to practical problems. In the field of agriculture, where the problems

are often complex because they concern living organisms, and therefore do not yield readily to the restricted methods open to individual specialists, team work has been especially valuable. It enables us to bear down upon an objective from many angles simultaneously.

What of the future? When we take stock of our scientific resources we realize that research has never possessed such potentialities as it does today. Moreover, these are being continually and rapidly augmented. The curiosity of yesterday becomes the commonplace of today. The radio circuit, in the experimental stage ten years ago, is now routine equipment, used in all kinds of laboratories for all manner of purposes. The statistical method is now used almost universally in both the planning and interpretation of experiments involving naturally variable factors, such as are so common in agriculture, yet most of the pioneers in this method are still with us, though a few, like Prof. J. Arthur Harris, of revered memory, have gone on.

On the other side of the picture, we recognize that there never was a time when agriculture stood in greater need of all the aid which science can bring than it does today. In spite of apparent over-production of some agricultural products, we know that production problems are by no means solved. Weeds, insect pests, plant and animal diseases, and parasites still cause staggering losses, which in these days of low prices the farmer can less than ever afford. By calculations based on the reduction of grain yields by weeds in experimental plots, we have estimated that weeds alone cost grain-growers of the three prairie provinces of Canada a loss of over forty million dollars in an average year. The crisis in marketing has directed attention to the need of more study of economics. While we must not fall into the error of supposing that economists can of themselves alone change anything, we must depend upon them to clarify and describe the situation by marshalling the facts in orderly array, thus providing the necessary base from which administrators can advance to shape policies and investigators in other lines to attack scientifically the problems indicated. To adjust ourselves successfully to changing conditions involves meeting many problems not less difficult or less challenging to science than the structure of the atom and the transmutation of the elements.

Why then should there be doubts in the minds of so many laymen as to the entire beneficence of research? Why should well-meaning bishops propose that science should take a ten-year holiday? Can we maintain the present pace of scientific advancement without risk of anarchy in other departments of society?

I referred earlier to Whitehead's illustration of the shortening time-span in human affairs. He believes that society has ceased to be stable, because the material progress that used to be spread over many gener-

ations now occurs within a single life-time, and human nature has not the capacity to adapt itself so quickly. Sir Daniel Hall, in developing this theme in a lecture entitled, "The Pace of Progress," which he delivered recently at Cambridge University, points out that the march of science is developing aspects destructive of our accustomed economy, and reaches the startling conclusion that the main use of all the complicated organizations governments in many countries have set up in an attempt to meet the economic dislocation is, by the reference and delay, commonly known as red tape, which they inevitably entail, to damp down the fire of the researcher, on the one hand, and of the promoter of his inventions, on the other, thus easing society of the strain of too rapid change.

Whether or not we admit such a thesis, we can at least agree that research may easily be hampered by too much organization. The administrator needs the wisdom of Solomon to strike the right balance between his desire to make research more effective by co-ordinating it and to avoid damping the enthusiasm of the researcher by imposing conditions irrelevant to his immediate interests. We can also agree with a second conclusion of Sir Daniel Hall, namely, that the course of science has to be broadened, not arrested.

Before throwing stones at politicians and economists for failing to devise systems which take adequate account of the changing physical equipment of society, we may well ask ourselves whether part of the guilt does not lie at our own door. In thinking of this, two things have impressed me particularly.

First, there is no doubt that scientific research has been quite generally debased in its purpose and outlook by commercial considerations. When Napoleon III asked Pasteur why he did not try to make his discoveries a source of profit, he answered, "Men of science would consider that they lowered themselves by doing so." How many of us would make such a reply? Today we are very much the tool of utilitarian interests. The enormous expansion of research in this century has been too largely for the purpose of increasing physical wealth and power. True, of course, much of the output of research during this period could equally well have been turned to higher purposes—and some of it has been. We have only to think, for example, of the vast educational and cultural potentialities of the radio and cinema. But even these have so far been made chiefly to serve commercial interests. We need not—indeed we cannot—be blind to the necessity of frankly industrial research, nor to its poteníalities for improving the standard of living and comfort of the people generally, provided the results are wisely and not merely selfishly exploited. None of us can evade our responsibility to

do what we can as individuals to maintain a purity of motive and outlook in research, and to cultivate in the public mind a proper respect for knowledge and a more reverent sense of stewardship in the use of the power which it confers.

Second, there is a kind of unbalance or lack of co-ordination inherent in our professional system. It occurs both within the field of science itself and between science and other fields of human thinking and endeavor. The price of specialism is thinking in compartments and progressing in grooves. Whitehead humorously illustrates the intellectual isolation of a present-day scientist. He says, "The modern chemist is likely to be weak in zoology, weaker still in his general knowledge of the Elizabethan drama, and completely ignorant of the principles of rhythm in English versification. It is probably safe to ignore his knowledge of ancient history."

There is an essential unity in Nature which we have largely disregarded in attempting to divide knowledge into water-tight compartments. It simply means that we have attempted to divorce it from practical life. Our civilization is now paying the price of dealing too much with fragments, to the neglect of the greater whole.

I would not appear to disparage the great progress which has been achieved even by fragmentary methods, nor take the ground that these were not the right methods to begin with. Analysis properly precedes synthesis. To resolve a subject into its constituent elements is often the only way to gain an understanding of it. Then again we can often deal successfully with parts of a problem which is too big to be tackled at once in its entirety. I believe, however, we have reached a point where more thought should be given to the problems of synthesis.

Without being so ambitious as Francis Bacon, who thought to organize the whole field of knowledge, we may still in our small corner think of our own possible contributions to science in terms of their value as building stones in a unified structure, rather than as monuments all our own. We have, of course, begun long since to do this in a limited way, as is evidenced by the growing practice, to which I have referred, of organizing research by projects, disregarding departmental boundaries in making up the required team of workers. That is all to the good, but it is not enough. We cannot escape our responsibility, not only as scientists but also as citizens, of thinking more about the implications of our work in relation to society as a whole.

In conclusion, I should like to add my humble but sincere tribute to the pioneers who founded and developed the work of this Minnesota Experiment Station. They entered the road to knowledge where it was little more than a woodland trail, rough and obstructed in spots, with

many dark corners to be cleared, and the solid foundation still to be laid. As one fruit of their labors, this trail has become a broad paved highway, where apparently the greatest dangers arise from the excessive speed of the new equipment. They have left their successors the job of devising traffic rules which will facilitate not only their own progress but protect the safety and interests of travelers in other walks of life at the frequent intersections. Putting the same thought another way, those who built up this Station have had the travail and the joy of sharing actively in a period of unparalleled development and expansion of research. Those coming after have a firm foundation to build upon, and they have the task of knitting their structure more and more closely with the larger structure of the life of the state and the nation, that its citizens may enjoy the full fruits of their scientific heritage. I myself and a number of my students and colleagues have sat at the feet of the men now guiding the research of this station, and have good reason to know that its great tradition is being maintained. These Minnesota leaders of today would be the first to say, like a great scientist once said, that if they have seen farther than their predecessors, it is because they have stood on the shoulders of giants.

ACHIEVEMENTS SESSION

Saturday Morning, June 15, 1935

Theme: Achievements

Presiding: F. J. Alway, Chief, Division of Soils, University of Minnesota Department of Agriculture

ADDRESSES*

1. Achievements of the Minnesota Agricultural Experiment Station, Andrew Boss, Vice Director.

2. Achievements of the Minnesota Agricultural Experiment Station, F. B. Snyder, President, Board of Regents, University of Minnesota.

3. Research as a National Service, F. A. Silcox, Director, United States Forestry Service.

* In addition to the above papers read, impromptu responses were made by C. L. Blanchar, J. V. Bailey, W. S. Moscrip, Ole Flaat, and R. A. Trovatten, of which no record was taken.

ACHIEVEMENTS OF THE MINNESOTA EXPERIMENT STATION

Andrew Boss

The achievements of a research institution such as an agricultural experiment station should be measured by the value of its contributions to the industry it serves; and by the additions made to knowledge of life and the universe of which it is a part. The number of experiments conducted, the staff members employed, the acres tilled, the square feet of laboratory space provided, or the pages of printed matter published, count for little unless natural laws are discovered and principles are evolved which will replace tradition, guess, and rule of thumb in the ever-increasing complexity of the problem of wresting a living from the soil. The degree to which the results of scientific research have been beneficially incorporated into the everyday operations of those who farm, thus reducing toil and risk and increasing comfort and satisfaction, is the supreme measure of the value of scientific research in the field of agriculture.

Measured in these terms, the Minnesota station has contributed largely to the agricultural industry and to advancement of the biological and social sciences as related to it. I shall not be able to present in the brief time allotted all of the achievements of this station. A summary of achievements has been prepared and published, however, which you may read at your pleasure. I wish only to point out at this time some of the major contributions of this station and their significance and value to present-day agriculture.

Crop Improvement by Plant Breeding

Fifty years ago farmers planted their crops by the signs of the zodiac or the light or dark of the moon. They selected their seed by the field or bushel measure and improved it by cleaning it thoroly with a good fanning mill. No thought was given to individuality of the plants from which the bushel came, or to the laws of inheritance as affecting quality of the crops. Fortunately for this station, Professor Porter brought to his staff in 1888 a man who had learned somewhere, or made the discovery, that plants have individual potentialities and that they respond to fixed laws of inheritance quite as readily as do animals. As early as 1890 therefore, W. M. Hays initiated plant breeding investigations which were destined to have wide-reaching influence and which proved to be the foundation for some of the most outstanding research work of

this country, if not of the world. Beginning with timothy plants and wheat, Hays rapidly widened the field until by the year 1900 he had included in the plant breeding program most of the commercially important crop plants. He, with his associates, developed methods for improvement by selection and hybridization, of all of the important field crops including the grasses and legumes. His enthusiasm for this work led him to travel widely and to solicit the cooperation of workers in other nearby stations. Agreements for cooperative exchange of ideas and materials were reached with Moore of Wisconsin, Shepperd of North Dakota, Chilcott of South Dakota, Burnett of Iowa, and others, thus stimulating interest in crop improvement and gaining supporters for the development of the science of plant breeding.

Grand Rapids Experiment Station, 1910

Not satisfied with local regional coöperation, Hays interested the Secretary of Agriculture and certain individuals in the U. S. Department of Agriculture. He also interested Spillman of Washington State, Buffum of Wyoming, Kezer of Colorado, and others too numerous to mention. Thus out of the Minnesota station flowed the vision of scientific improvement of crop plants through controlled inheritance, which has now developed into a nation-wide movement and out of which has come not only a knowledge of the branch of science known as plant genetics and breeding, but which has also contributed much knowledge in the field of animal breeding.

That the same principles and methods would apply to fruit crop breeding soon dawned upon Hays. Characteristically, he pressed his views upon his associates and particularly upon his colleague, S. B. Green, horticulturist of the station. The inoculation took, and with energy and determination Hays and Green went after a suitable location for that kind of work. As a result, the fruit breeding farm, said now to be one of the largest and best equipped fruit breeding centers in

the world, was established near Lake Minnetonka, thus completing the equipment of the station for a well-rounded program of crop improvement by the scientific control of plant inheritance.

Within six or eight years from the date of initiating the plant breeding nurseries, new strains and varieties originating in plants of known inheritance and quality began to replace the ordinary and miscellaneous stocks furnished by seedsmen or secured by exchange with neighbor farmers. Minnesota No. 13 corn, originated by selection, and Minnesota No. 169 wheat were two of the first introductions made. The former is still much used by the farmers of Minnesota and is a popular variety in certain areas outside the state.

These served only to sharpen the desire of farmers for other varieties of known inheritance and performance. The science of plant breeding has been advanced, knowledge has been gained, and methods improved, until varieties are now made to order to meet the increasingly exacting needs of soil types and climatic and biological conditions. Another Hayes (H. K.), trained and skilled in the knowledge and technique of making plant combinations that fill a place in our crop economy, with his able associates, now carries on with commendable enterprise and success the work so inconspicuously started at the Minnesota station by the first Hays nearly 50 years ago.

Out of the early ventures in plant breeding has grown another branch of science which also has brought renown to the station and added greatly to its achievements. Black stem rust is an arch enemy of the wheat crop, causing great losses to farmers who grow the crop. It became necessary to learn the nature of this parasitic organism in the attempt to produce a wheat that would resist epidemics of the disease.

In the search for someone who knew the life history and habits of stem rust, a young scientist by the name of E. M. Freeman was added to the staff. Intensive researches were set in motion, assistants added, and discoveries made. Science again moved forward, and plant pathologists began to contribute to the science of plant breeding. In that field the station, through E. C. Stakman, associated with Freeman and others, has won international renown for the discovery of the phenomenon of physiologic specialization among many plant parasitic fungi that cause plant diseases. The results of these studies have assisted in explaining the behavior of plant disease epidemics and have been valuable in the development of disease-resistant varieties of crop plants. And this is an important fact in the making of varieties to order, in which task pathologists and plant breeders now work in close cooperation.

Without attempting to express in financial terms the value of these new varieties, appreciation of their good qualities is indicated by the

fact that 60 to 75 per cent of the crop land of the state is now seeded annually to varieties originated by scientific crop breeding practices. To date, approximately 30 varieties of crop plants have been disseminated among the farmers, most of them finding a permanent place in the crop production of the state and the northwest.

Results from the fruit breeding nurseries have been equally well received. The northwest is under necessity for winter-hardy fruits of good quality. These did not exist in Minnesota prior to the establishment of the fruit breeding farm. In the short quarter century since it got under way, 36 varieties have been offered, and all but 5 or 6 have become commercially important. Out of 125 nursery catalogs examined in 1934, all but 11 carried stocks of these varieties.

General View of the Crookston Station and School Buildings, 1910

If popular use is a criterion, the station has achieved signally by setting in motion the movement in plant breeding which has now encompassed the country from coast to coast—nor has it stopped at national boundaries.

New Feeding Standards for Dairy Cows

Governor W. D. Hoard, the great apostle of dairying, is said once to have remarked that there was no place on earth so dark as the inside of a cow. Prof. T. L. Haecker, an able disciple of Hoard's, who joined the staff of the Minnesota station in 1891, seriously undertook to learn what went on in this darkest of places.

For a period of 25 years he studied individual cow performance, measuring input in feed units against output in product and accounting for the difference in terms of body needs for growth and maintenance. So well did he succeed in finding out what went on in the working machinery of the cow (and in her mind if she has one) that he was able to present to the world revised feeding standards for dairy cows. These were based on the cow's needs for energy and body maintenance and on the quantity and quality of the product returned at the pail.

Dairymen were quick to adopt the Haecker standards as they were built upon economy of feeds and lessened by 10 per cent or more the feed unit requirements per unit of product. These standards, published

as a station bulletin in handy form as a pocket manual, may still be found in the dairy barns of this and other states. Over 200,000 of these were published on repeated demands from the dairymen for them. This fact alone should give positive assurance of station achievement on this score at least. But the work on dairy rations led also to studies of the body needs for growing and fattening animals. The same careful methods of studying body needs used in feeding dairy cows were practiced, followed by slaughter of animals at scheduled age or weight, and analysis of the component parts of the body. The results of this study stand also as a classic in animal husbandry research, and are rated as an outstanding achievement of the station.

One more project in the animal field deserves special mention because of its wide importance in successful animal production. It is the one concerned with the problem of mineral deficiencies in food products and feeding rations. Noting symptoms of undernourishment and depraved appetites in cattle raised in certain sections of the state, the late Dr. C. H. Eckles, who succeeded Haecker as chief in dairying, in cooperation with the nutrition and soil chemists of the station began a series of studies to determine the cause. The results disclosed the fact that because of deficiencies or lack of balance in certain of the mineral elements, notably phosporous and calcium, forage crops were deficient in these elements, resulting in great loss in efficiency of production in nearly one half of the state. By corrections in soil treatment and in the feeding rations, as advised by the station, these losses can now be overcome and efficient production restored. This discovery also merits a prominent place in the list of achievements of the station.

The Cooperative Creameries

The list of achievements in the dairy field would not be complete without reference to the work of T. L. Haecker, McGuire, and their associates in bringing into being the great cooperative organization known as Land O' Lakes Creameries. The "gum shoeing" of Haecker in '91 and '92 among the creameries and dairies of the state gave him a vision of the possibilities for improvement in quality of product and in prices for dairy products. The history of this movement is too well known to this audience to need repetition here. It must be accounted, however, as one of the truly great achievements initiated and stimulated by the station.

Introduction to Farm Economics

"Believe it or not" there was a real depression in the early years of the station (1885-1895). Times were hard and prices low. The phrase "cost of production" must have been invented at that time. At

least it was frequently heard. In an effort to learn the comparative production costs and profits from different crops W. M. Hays and the writer set up a series of rotation plots at University Farm in 1894, where it was hoped helpful information might be obtained. The information was to be used in setting up more profitable systems of farming in the state. A few years of trial revealed the error in this attack. It was too artificial and too limited in scope. Then followed in 1902 the initiation of the statistical route method of studying the business of farming where facts were recorded daily of the operations and transactions on farmer-operated farms as they actually occurred.

Hays, again the lead-off man, contacted the Bureau of Statistics of the U. S. Department of Agriculture, and induced the chief to contribute both in personal advice on methods to be employed and in funds for meeting field expenses. Later through his connection as Assistant Secretary of Agriculture he promoted the office of farm management in the U. S. Department of Agriculture, and through it and W. J. Spillman, a quick convert to the idea, nationalized the project in a broad way. The fires of farm management research kindled at this station in the years 1894 to 1905 have burned on to this day, with much new fuel being added as the science of agricultural economics has developed. No institution has contributed more to an understanding of the principles governing good farm business organization than the Minnesota station.

The Chemists Contribute

Fifty years ago chemists were classified as natural scientists, and taught the first agricultural courses offered in the University of Minnesota. Chemists always have played a leading part in the application of science to agriculture. There has been no lapse in diligence or contributions from the chemists of this station. The studies of cereal chemistry, initiated by Harper, the first chemist of the station, in association with W. M. Hays, in connection with wheat improvement, have been followed successively by Snyder, and later by Thatcher, Bailey, Gortner, and associates. No variety of wheat is now offered the public until the cereal chemists have determined its acceptability as a satisfactory milling and baking variety. Because of their nature, the results of chemical researches are most often expressed through their applications in other subject matter fields as the chemists contribute to the solution of crop and animal problems. However, the achievements of the chemists of this station in cereal, nutritional, and colloid chemistry, are outstanding. These are presented in condensed form in the bulletin summarizing the work and achievements of the station.

Livestock Sanitation

The relation of animal disease to human health has been definitely established. Livestock sanitation is now considered to be a large public responsibility. One of the first to become interested in this problem was the late Dr. M. H. Reynolds. He studied the efficacy and methods of application of the tuberculin test in finding infected animals in a herd. He also helped to formulate and develop the policies of the Minnesota Livestock Sanitary Board, of which he was for many years a member. This work led to the formulation of a plan for officially accrediting herds that had been tuberculin tested and found free of the disease. The plan was adopted by the State Sanitary Board and with certain modifications by the federal government as the best method of giving official recognition to herds found free of the disorder.

Investigations made by Fitch and associates in later years of the widely spread "Bang's Disease" have likewise led to great advancement in livestock sanitation. Working in close cooperation with state and federal officials, laboratory studies at the station have contributed materially to the application and standardization of the agglutination test as used in the segregation and elimination of diseased cattle.

To the research work of the veterinarians of the station is due in no small measure the protection offered to human health by the present laws governing livestock sanitation.

Insect and Parasite Control

In a manner somewhat similar to that employed by the veterinarians in protecting human beings from animal diseases, the entomologists have given assistance in gaining protection from insect pests and parasites. The fundamental studies of the physiochemical principles involved in the proper spreading of spray mixtures on plants and their adhesion to the leaves have led to recommendations of great practical value to orchardists and gardners. Likewise, extensive studies of the relative toxicity of new or little-used fumigants and the temperatures at which they were used led to nation-wide recognition of formulas proposed for the control of insect pests in stored cereal and other food products.

Miscellaneous

I should like to discuss further still other fields of investigation that have brought equally valuable achievements. Time, however, will not permit. I can only refer in passing to the importance of the location by the soil chemists of phosphorus and calcium deficiencies in the soils of the state; to the importance of formulas for the redemption of some 20,000,000 acres of sand and peat land; to the assistance given to crop

producers by advice on soil classification and treatment; and to the fundamental qualities of drainage studies by the agricultural engineers.

The Organized Attack

Before closing, I wish to call attention to two other achievements which in my opinion take high rank in the list coming from the Minnesota station. The first is the organized attack on research problems. This, like many of the others I have discussed, leads back to early days. When W. M. Hays, as agriculturist, began to solicit and attract the assistance of others in his wide fields of activities, he set up simple statements of the part each was to take in the venture and outlined the course of procedure to be followed. When he went to Washington in 1905 as Assistant Secretary it was his hope to have the idea adopted by the Department of Agriculture in setting up not only the research work of the department, but also in setting up cooperative agreements with workers in the states. The workers of the department were cold on the subject, however, and not then ready to adopt it, tho the cooperative agreement and the project statement are now well established there. At this station the organized project was adopted when the Adams funds became available, as a means of getting approval from the O. E. S. on investigations to be supported from that fund. It has proved useful also in developing cooperative work in the station where the training and skill of scientists in various fields are required in solving some involved complex problems of large proportions—e.g. the mineral deficiency problem, where soil chemists, nutrition chemists, dairy men, and veterinarians were all called into use; or in the development of Thatcher wheat, where geneticists, plant breeders, pathologists, cereal chemists, and field agronomists united to create a variety of wheat highly resistant to stem rust, of high yielding ability and of satisfactory milling and baking quality to meet market demands. The organized project attack is no longer a local institution. It has been adopted universally and is one of the important contributions of this station to the advancement of agricultural research.

Trained Workers in Agricultural Research

The final illustration of achievement that I wish to note is the productiveness of the experiment station as a laboratory for training technicians and scientists in the various subject matter fields. When the University accepted the responsibility for providing and operating an experimental farm, it was difficult indeed to find a suitably trained man to take charge of the new venture. There was no literature of consequence on agriculture and few text books were available.

How different the picture now. Through the records of the graduate school as analyzed by Dr. Gortner, chairman of the agricultural group, at the close of the June 1934 commencement 640 students had been granted the Master's degree and 263 had been granted the degree of Doctor of Philosophy in agricultural subjects. Approximately one-fourth of all the Master's degrees and approximately one-third of all the Doctor of Philosophy degrees which have been granted by the University of Minnesota have been in the field of agriculture.

Foreign students in very considerable numbers have been attracted to the agricultural department of the University, and 59 have received the Master's degree and 49 the Doctor's degree. Most of them have returned to their homeland where they have practiced techniques with which they became acquainted in the laboratories of the Minnesota Agricultural Experiment Station, thus contributing an international influence.

In January, 1934, a study was made of the present occupations of 654 individuals who had received advanced degrees (428 M.S., 226 Ph.D.) in agriculture at the University of Minnesota. Approximately one-third (216) were teaching in colleges or universities, in most instances in agricultural institutions. Of these teachers, 57 held the rank of professor, 37 the rank of associate professor, and 62 the rank of assistant professor. Twenty-eight were heads of their subject matter departments.

Another large group, approximately one-fourth (169) of the 654 individuals, were in the service of the federal government or in various state non-teaching positions, in most instances in agricultural experiment stations. In addition, 51 more were in similar positions in the service of foreign governments. Of the entire group of 654, it was found that 453 were either teaching in colleges or universities or were in government service, and nearly all the rest were engaged in some occupation directly related to agriculture. Only 18, or 2.7 per cent, were definitely classified as being in non-agricultural fields of activity.

Thus the Minnesota Agricultural Experiment Station has trained workers in agriculture for every state of the Union and for 16 different foreign countries. This wide dissemination of research ideas and agricultural techniques must be recognized as one of the outstanding achievements of the station.

Some may question the value of such achievements when measured in terms of expense and returns. The wide adoption of the results of these researches into the everyday affairs of agriculture speak well for their value. Careful estimates indicate that the increased returns from any one of the major achievements here discussed more than compen-

sate for the cost of maintenance of the station from the date of its establishment. In combined effect, their influence is stupendous even when measured in cold dollars and common red cents. The station has served the state and the agricultural industry fully and well, but it is even more necessary now than in the early days when the industry was less complicated and competitive.

It has won the confidence and respect of thousands of farmers who like the farmers of a half century ago find it impossible to pry individually from Mother Nature many of the closely guarded secrets that so greatly influence their business. The ability to win that confidence and to turn farmers' minds toward reliance upon facts gained through research and to apply the findings of science to their everyday business is not by any means the least of the achievements of the Experiment Station.

ACHIEVEMENTS OF THE MINNESOTA EXPERIMENT STATION

F. B. Snyder, Vice Director, Board of Regents,
University of Minnesota

In 1868 the legislature authorized the Regents of the University to purchase land for experimental work in crops. A tract was bought adjacent to the present main campus in Southeast Minneapolis. The land was not well adapted for the work. In fact, the endeavor was something of a fizzle as an experiment station, but as a real estate investment it was a flattering success. The land cost $8,500 and was sold for $128,000. With this money land for the present University station was bought, and a farm house, barn, and station building were erected. The work done by the station since then has been of incalculable value to the wealth and progress of the state. It is proper that this semi-centennial anniversary should be acclaimed with considerable pomp and circumstance.

The impetus for the growth of the station came in 1885 when the legislature accepted the provisions of certain Federal Acts granting financial aid to the station upon the condition that the station would pledge itself to carry on by research and to solve by experiment all the problems relating to soils, crops, farm animals, foods, plants, trees, and their habitat, diseases and remedies, and to investigate the scientific and economical qualities involved in the production of butter and cheese, as well as any other form of research and experiment bearing directly

on the agricultural industry of the Nation having special regard to locality. In addition to all these purposes, federal money is also provided for the training of teachers in the field of education assigned to the station.

The Federal Acts also authorized the station to use net funds derived from the sales of farm products and other property in the possession of the station resulting from its experimental work.

Within the fifty-year period, branch stations have been established at Crookston, Morris, Waseca, Grand Rapids, Duluth, Owatonna, Cloquet, Itasca, Albert Lea, and at Lake Minnetonka, now Zumbra Heights. The area covered is as large as all of New England and half of Indiana and offers for investigation and solution problems of a similar nature but which must have different approach by reason of the unusual diversity of soils, water, glacial and non-glacial areas, alluvial deposits, moraines, marshes, peat beds, prairie land, hard wood, soft wood, and coniferous timber belts, the fall of rain and snow, killing frosts and insect pests characteristic of Minnesota, as a whole, and their influence on adaptability of location to market, in order that the welfare of farm life in the several districts may be best served by attacking at close range its special problems.

The approximate amount of money received by the station since 1885 from the Federal Government is $1,685,000, and, from the sales of its products, $727,000. In addition, the State has contributed approximately $4,714,000, thus making a grand total outlay of approximately $7,126,000, for the use and maintenance of the station and its branches since 1885. This is a large sum of money. A natural inquiry is: Have the results justified the outlay?

Out on the highway near Manitou Station, Lake Minnetonka, is a bronze tablet upon which the passer-by may read this memorial:

"This Tablet commemorates
Peter M. Gideon
who grew the original Wealthy apple tree
from seed on this homestead in 1864."

In 1878 the Regents bought land for experimental work, adjoining the Gideon homestead and placed Mr. Gideon in charge. As a result of Mr. Gideon's pioneer work on his homestead, supplemented by his work on the farm, the apple industry in Minnesota, with its splendid Wealthy apple, became firmly established and has greatly enriched the State. Perhaps it is not doing too much to place Mr. Gideon in the very forefront of those who, following the trail blazed by him, have during the last fifty years added millions of dollars to the wealth of our farmers.

There are other speakers who will extol the names and deeds of

those who have brought this success. My time is limited. I can give only general results.

University authorities assure me that, to the best of their knowledge and belief, the gross earnings of the farmers of the state in excess of the amount they would have earned without the work done by the station, approximates annually, more than $50,000,000. With a look backward and a look forward, you may multiply this sum by whatever number of years satisfies your best judgment and I am sure you will say the outlay of $7,126,000 has been like good seed sown in good soil with an hundredfold and more return.

The services of the station measured in dollars is only part of the story. Add the value of the teachers trained at the station who have been employed at home, in Canada, and in distant parts of the earth to advance the work of the station and one may more fully realize the splendid career of the station during the past two score and ten years.

Let us continue our whole-hearted support of the station; let us spread to the four corners of the earth its good name and fame; let us bid the station stand up and advance to the court of awards, so that we may publicly bear witness of its glory and bestow the laurel wreath for conquests undertaken and victories won over some of Nature's hidden secrets, to the enduring benefits of all the people.

SCIENCE IN THE SERVICE OF SOCIETY

F. A. Silcox, Forester, United States Department of Agriculture

The scientist's obligation to society is a most timely and fitting topic for discussion at the birthday celebration of a scientific institution. The mere fact that such a topic has a place in your program is in itself indicative and symbolic of the strivings and ideals of the Minnesota Agricultural Experiment Station during its fifty years of service to the agricultural interests of the state and to human knowledge in general.

It is, therefore, a great privilege and honor to be invited to share with you in well-deserved rejoicings over achievements of the past, and in charting a course for still greater achievements in the future.

My approach to the subject of the scientist's relation to society is not from the standpoint of a scientist interested in the advancement of science for its own sake, but rather from the standpoint of a man who sees in science and the scientific method the greatest instrumentality man possesses for bettering human life—a key to the solution of many

physical, economic, and social ills which beset humanity. I am intensely interested in the mechanisms and processes by which scientific discoveries can be translated into actual life, and how the blessings of man's inventive genius can be diffused among all the people instead of redounding to the advantage of a few.

Science has wrought profound changes in human life and is remaking the world. It is hardly necessary for me, before this group, to point out the debt which society owes to science. A recital of the achievements of science would practically mean tracing the evolution of mankind from barbarism to its present state of civilization.

There is no single detail of our individual and community life, whether in matters pertaining to health, transportation, modes of communication, agriculture, or productive industry, that has not been created through science or its application. Science has influenced not only the material culture of man, but also his intellectual outlook. It has interpreted the physical world in which he lives, and even his own mental and emotional processes.

Whether all the applications of science in our modern life are of indisputable social value, and whether people as a whole are as contented and happy as they were in simpler times, may be open to question. Yet there is no turning back. The interest and the zest of life have certainly been greatly stimulated by the technological applications of science. They have contributed to greater comfort, conveniences, and, especially in this country, to a higher standard of living and prosperity—illusory as this term may be.

Yet, in spite of all these achievements, science today finds itself on the defensive, not so much for what is has done, as for what it has failed to do. Science started out proudly to create a happier world, one free of poverty, disease, and human suffering. Some 300 years ago, Francis Bacon announced that "on the truth of nature, we shall build a system for the general amelioration of mankind." From time to time royal academies of science and other scientific bodies throughout the world have made similar claims.

This is not the first time that science has been made the target for attack, but today it is being attacked, not as in the olden days by the theologians who feared the scientist's encroachment on the spiritual prerogatives of the church, but by the man in the street and on the farm. The average man has begun to doubt whether scientific research and the labor-saving inventions which have come as a result of its technological applications, have accomplished all of the claims that the scientist would have them believe.

Some seriously suggest that science should take a holiday, that there should be a moratorium on scientific research in order that society may

catch up with itself. Legislative bodies reflect this sentiment in their attempts to curtail appropriations for scientific work and education in general. Even the agricultural experiment stations share the blame for the present economic difficulties of the farmer, because they taught him how to wrest more bountiful crops from the soil.

The scientist must realistically face the situation. Instead of being impatient and bitter against his critics—as some of our physicists have been—he should dispassionately analyze in a truly scientific spirit the causes of this dissatisfaction.

What are some of the criticisms leveled against science?

There is a general feeling, shared by many liberal-minded scientists, that thus far the greatest contribution of science has been to the materialistic development of our society, and not to social betterment or the improvement of human relations. That there has been social progress, of course, cannot be denied. It is enough to survey the progress of our country during the last 100 years. From a small agricultural population, settled on the fringe of a vast, rich, and virgin continent, eking out a bare existence by hard and arduous labor, we have grown to an industrial country of 125,000,000 people. During this time we have abolished slavery, we have conquered the ravages of many diseases, we have raised the standard of living for all, we have greatly reduced the hours of labor, we have expanded the opportunities for education in schools, libraries, and museums for the bulk of our people, we have steadily limited the abuses of private property, and today we are on the threshold of other great social reforms. This is certainly a great social advance for the American people.

Yet the attainment of this social betterment has come more as a result of the struggle of the people themselves, with the scientist too often found away from the fight or on the other side of the battlefield. At the same time, the scientific progress in the materialistic field created new social problems, to the solution of which most of the scientists remain indifferent.

For a number of years, I served as a counciliator between labor and capital in the printing industry and have had occasion to observe the effect of the introduction of improved technological processes on the workmen at close range. When a new machine which one would expect to lighten the labor of the workers was installed in the shop, hundreds of men were thrown on the street to shift for themselves as best they could. Some of these men were beyond middle age and had spent the best part of their productive life in the printing shop.

What has happened in the printing industry is happening in practically every other industry. The machine, which was to be man's servant, became man's chief competitor. Some large power plants to-

day generate power equivalent to the labor of four or five million men, and yet are controlled by a single man.

Although the application of machinery in agriculture has not displaced many farm hands, the labor of the farmer, himself a worker, has been directly lightened by machinery. Yet, the tractor-drawn harvester and gang plow has narrowed the opportunity for labor on the land, and the cotton-picking machine is a real threat to hundreds of thousands of hand pickers and to the whole economic life of the south.

The road-making, track-laying, concrete-mixing, and electric welding machines have displaced thousands of city laborers; the dial telephone dismissed an army of switchboard operators, and countless other illustrations could be cited to show how the application of scientific discoveries throws men out of jobs faster than new industries can absorb them.

The cause of international peace, for which mankind is striving, is cruelly threatened by the prospects of even more horrible warfare, made possible through the invention of high explosives, harder steel, faster bombing planes, more poisonous gases, and even the spread of deadly bacteria—all based on scientific discoveries in physics, chemistry, and bacteriology. The discovery of new drugs, new food values, are commercialized and used to exploit the credulity of the public.

I recall another illustration from my own experience in the industrial field. The methods of testing intelligence and personality traits, contributed by psychology, are of great value in determining the mental differences in individuals and their aptitude for certain lines of work, and hence are a great boon to education and to science. The personnel managers of our industries soon discovered that by applying psychology they could pick the higher levels of ability at the wage for which the lowest ability could be obtained. As a result, the individuals tested—the workers, and, most tragically, those thus rejected—have not been benefited, and the acute social problem of unemployment has thereby been intensified rather than solved.

Psychology has also been pressed into the service of advertising, to make people buy commodities which they often do not need or which have no intrinsic value. Psychology, through the knowledge of personal differences, is being exploited to furnish justification for the existent inequalities of our social order, the establishment of race superiorities, fomenting but hatred and strife.

Science, through its technological applications, has produced potentialities of plenty, of ease and security for all. Yet the people in most advanced industrial countries, and in the United States, are confronted with the spectre of want, hunger, and misery, in the midst of this possible plenty.

Is it possible that science, in transforming life, has unconsciously created social problems of such vastness and complexity—a new Frankenstein—before which it stands itself helpless, overpowered by the results of its own intellectual triumph?

The scientist, of course, can honestly say that he is not responsible for the use to which his discoveries are put, and that it is the inventor and the engineer, in partnership with business and modern supersalesmanship, that deprive the people of an equal share in the benefits of his discoveries. Yet the scientist cannot entirely escape the moral responsibility for the consequences.

That the question of responsibility has been raised is well indicated by the tenor of recent meetings of both American and British associations for the advancement of science. In an address before the American Association for the Advancement of Science, in January 1934, the Secretary of Agriculture challenged the assembled scientists and engineers to tell where they were heading. He appealed to them to bend their talents to higher human aims than the mere increase of productive power. Similarly, a recent meeting of the British Association at Aberdeen devoted its entire program to a consideration of the social consequences of scientific discoveries, and the Bishop of Carlisle, in his sermon, asked the scientists whether the time has not come for science to abandon its severe spirit of aloofness from human problems.

At the time of economic and spiritual crises, like that through which we are now passing, all habitual values are challenged, among them the place of the scientist in society. In a period when the foundations of our civilization are being remade, the scientist must redefine and re-evaluate his attitude toward the world in which he lives. He is confronted with a moral problem.

Is it the failure of the scientist or of our democracy that scientific progress, instead of bringing about a more contented life and greater economic independence for all, has added to the economic insecurity and the chaos of the present social order? The answer, in my opinion, is that the responsibility rests both with society and the scientist.

It is, of course, not the fault of the scientist alone that our modern society, in which he works, is dominated by acquisitive psychology which considers the interests of individuals or special groups as the mainspring of economic progress, often based on the honest conviction that what is good for business must, therefore, be good for everybody. Under such a system every scientific discovery which leads directly to the development of industry and manufacture is sooner or later commercialized, with consequences—sometimes good, sometimes bad—over which the scientist who made the discovery has no control. For the most part, these scientific discoveries are made at public expense and

rightfully belong to all the people. Yet society may derive only a comparatively small share of the benefits.

The fault of the scientist is, however, that, as a general rule, he does not take sufficient interest in social problems and human relationships. The nature of his work lays a heavy demand upon his time and thought, and while the world is being made over by the fruits of his labor, he himself is remote from immediate social activities and interest. He feels that his entire obligation is to uncover the truth within his specialized field, and that it is up to the political scientist, economist, statesman, and politician to see where his discoveries fit into human life.

While we were a young, rapidly growing country, struggling to get a foothold on this continent, most of our energies naturally went into the development of the still untouched natural resources to meet the needs of an expanding nation. This was the period of building up the nation's productive power, of developing our resources, and of creating technique. The country was large, the resources unlimited, and every advance in science or improvement in technical processes meant greater prosperity and economic independence for all. During this period, the scientist has richly contributed to the development of this continent.

Conditions have now changed. The country's potential capacity to produce, according to recent investigations, is more than capable of keeping pace with its potential capacity to consume. The battle over the productive forces of nature has been largely won. There is no longer any question as to the capacity of our industrial and agricultural plants, or as to our technique to provide a life of fair abundance for all. If such abundance is denied to millions of our citizens, it is due not to the lack of knowledge of how to produce but to failure to provide a large part of our population with the means for purchasing the available basic commodities and conventional necessities. While the average standard of living of our people is still possibly the highest in the world, the gap between the incomes of the different groups in our society is also the greatest and is constantly growing wider.

According to the findings of the Brookings Institute of Economics, production in this country, with existing methods, can be increased 20 per cent above the level of 1929, or by about 27 billion dollars above the actual consumption for the same year, a peak year of prosperity. According to the same findings, there exists in the unfulfilled wants of the masses of the people, both rural and urban, a practically unlimited potential demand for basic commodities and necessities. If the earning power of every low-income family could be increased to $2,500, a market for consumer goods equivalent to some 16 billion dollars would be created. To absorb the 27 billion dollars, which is the difference

between the potential production and the potential consumption, this earning power would have to be still further increased.

The need for further scientific research is now just as great, if not greater, but today there rests on the scientist an additional responsibility to see that the fruits of his labors are more equally diffused among the large masses of the people. Aside from any question of social justice, if there is no such diffusion, our entire economic structure may be weakened if not threatened with utter collapse.

Dean Coffey, in an address before the American Association for the Advancement of Science in 1931, fully recognized this need when he suggested the introduction and expansion of political science in the curriculum of our agricultural education. Dean Coffey said that "if we are to secure the full benefits of natural science teaching and research under present conditions in agriculture, we must have a sound and adequate development of social science. It is the science upon which we must rely for finding the ways and means of making adjustments, of balancing production to the needs and desires of the people. Unless these things are done, natural science teaching and research will be greatly weakened as a potent influence in rural life."

Such a step would undoubtedly be of great help in providing a more careful consideration of the economic and social aspects of agricultural production, but the problem seems to me much broader than merely the remaking of courses in science, desirable as this is. Every worker in natural or physical science should himself become more socially minded, should cultivate a certain mental attitude to the problems with which he deals. What is needed is the inoculation of the research worker with a social point of view, with a critical mental attitude not only to natural but also to social phenomena, and the inoculation of the political scientist with the use of the scientific method in the study of human relations. It does not mean that the bacteriologist, for instance, should become a specialist in taxation or the monetary system, or the economist versed in the theory of light, but that both should develop a mental attitude, a social point of view, that will enable them to evaluate the results of their work in terms of human welfare.

After all, when you analyze it, the universal needs of men are few. The people are striving for food, for shelter and health, for assurance of protection from dependency in old age, for escape from drudgery to leisure, for education for self and children. There are only a few simple eternal truths affecting all human relations, and these were well formulated nearly two thousand years ago by the Carpenter of Nazareth.

It is not an uncommon thing to find among research workers in the sciences a peculiar inconsistency. When they deal with natural phe-

nomena, they fearlessly question every premise no matter how authoritative it may be; they scrupulously check the results of other scientific men and boldly experiment with new things. When, however, they enter the field of economic and social relations, they accept without questioning established social and economic beliefs. They fall back upon the myth of an unchanging human nature and the so-called immutable economic laws of supply and demand. Nature they conceive as being in a constant state of change and evolution. When they come to human society, they accept it as static, not subject to change. They are afraid of social experiments. In a word, in social matters the research worker often ceases to be a scientist and accepts uncritically the prevailing ideas and prejudices of the mass. The result is that too many of us are busying ourselves to adjust the needs and desires of the individual to an existing social order, which we accept with a sense of finality, when we should be adapting the social order to the universal needs and desires of man.

Any branch of science, any profession, any field of activity, must, in the course of time, assume a certain identity, almost a personality, which becomes symbolic and interpretative. It must develop an ethical code and a social philosophy.

Medicine has come nearest to developing just such a code of ethics. The Hippocratic oath demands that the physicians concentrate upon the problems of health and disease, and that they use their knowledge for the welfare of the individual, regardless of position or caste. The problem of medicine has been relatively easy. Kings, priests, generals, and even the heads of big industries do not find advantage in a population that is sick. To be free, medical research, speaking relatively, has not had to fight the acquisitive interests. Profit-making has no enduring conflict with health. Everyone covets health not only for himself but for those about him. Thus it is that medicine is free to regard a bad liver merely as a bad liver in a king or in a laborer, and free to conduct the research which makes medical knowledge available equally to all.

I may possibly be pardoned if I draw for another illustration of this idea on the experience of the Forest Service. When in 1905 the Forest Service was entrusted with the administration of the National Forests, then known as forest reserves, the Secretary of Agriculture, James Wilson, laid down a few very simple commandments. "In the administration of the forest reserves," he said, "it must be clearly borne in mind that *all land is to be devoted to its most productive use for the permanent good of the whole people,* and not for the temporary benefit of individuals or companies." Another of his commandments was that "where con-

flicting interests must be reconciled, the question will always be decided from the standpoint *of the greatest good for the greatest number in the long run.*"

This has been the philosophy, the guiding star, and the inspiration of the Forest Service for the last thirty years. The Forest Service has made mistakes in the past and doubtless will make some in the future, but as long as these simple rules shall motivate its activities and be used as the yardstick of all its decisions, it cannot fail to render real service to the people and enjoy their respect and confidence.

The scientist must assume a new function in society. His obligation in society must not end with the creation merely of new products and new techniques. In the age-old struggle between selfish interests and social welfare, which is bound to become more acute as time goes on, the place of the true research worker is on the side of the forces battling for the public good.

Science as a social service will come into full fruition only when the scientist will be free to pursue his calling unhindered by vested interests, by political or economic creed, or by religious bigotry. He must be free to announce the truth to which his trained judgment may lead him. On this point, the scientist must take a firm stand; be militant, if necessary, at the same time preserving his open-mindedness and his critical and unbiased attitude on all other natural and social phenomena. It requires courage to take such a stand because it may provoke hostility and even anger from every interest threatened by such an attitude, but as Harold J. Lasky well puts it in a recent article on "Universities in these Times"—"Those who are silent because of the truth within them may be inconvenient or costly or dangerous, in the end will become silent because they have nothing to say. The man who suppresses the thing he believes, he knows to be truth, will in the long run neither teach well nor research well, for neither task can be performed when one has the lie in one's soul."

The goal of the scientist is to advance human knowledge and man's power over the forces of nature in order to build a better and happier world. To every problem that we undertake to investigate, we should apply the inquiry, how will it affect the farmer, the worker, the man on the street; in a word, where does humanity come in? When we can show that whatever we undertake tends ultimately to benefit mankind as a whole, we are on the right road to our goal. If our investigations take us away from human needs, and do not serve as a means for social betterment of the life of the masses, then we know that we are getting away from our goal. The welfare of mankind should be our mistress who should command our thoughts.

Much has been written about pure or so-called fundamental and applied sciences. If we were sure that our investigations served the needs of the people, made their life happier and broader, we would not need to bother about whether the problems which we are studying are fundamental or not. They are fundamental as long as they serve to better human life. No matter whether a study takes us into the abstract and unknown fields of physics or physiology, or into known fields of established facts, the inspiration for the solution of the problems must come directly or indirectly from actual contact with life.

Many important discoveries in pure physics by Lord Kelvin were prompted by such impetus, as for instance his desire to improve the mariner's compass, the sounding machine for vessels, or by the need for improving the submarine cable for the transmission of telegraphic messages. These immediate practical problems led him into the realm of physics and mathematics, in which he accomplished so much. It should not, therefore, be below the dignity of any scientist to undertake research that has an immediate practical application, no matter how humble it may be.

Science, like real art, must serve mankind and be true to life and to life's needs. Such things as science for science's sake, and art for art's sake, are sheer humbug. They are compatible neither with true science nor true art. I suspect these particular slogans have been invented by the mediocre scientist and by the uninspired artist who lacked the touch of human life in them, and thought that they were working in a field which had no relation to life.

Research workers have still another social obligation. The possibility for the scientist to carry on scientific work, with all its enjoyments and living in a higher plane of ideas, is usually bought at the expense of someone else who does the rough, humdrum manual work of the ditch-digger, the miner, or the street-cleaner. If he realized this he would more keenly feel the moral obligation to repay these men by striving to make their lot better, by spreading among them the knowledge which he was allowed to acquire while their development was retarded.

I believe it was James Truslow Adams who once remarked that the cure to the ills of democracy is *more* democracy. The same may be said about science; the cure to whatever weaknesses that there may be in science is *more* science. Given the social or what I prefer to call the human point of view, I can foresee even a greater field of usefulness for science in the future than in the years past.

We, who are engaged in the field of agricultural science—and I include here most emphatically the conservation of all renewable natural

resources, need not be reminded of our social obligations. Our work is tied up too directly and intimately with the everyday life of millions of people. The agricultural scientist, whether working with cereal diseases, animal husbandry, dairying or any other branch of agriculture, unlike many other research workers, need not depend on intermediate commercial agencies to put his results into practice. Some six million farm families, or about one fifth of the entire population, are closely watching the progress of his research, and as soon as the results prove their practical worth they find a ready application.

The opportunity for science to make timely and valuable contributions toward recovery and reconstruction is nowhere better illustrated than in the recommendations of the President's National Resources Board. The Board lays out a long-time program for a planned development of our country. The carrying out of this program requires a greatly expanded program of explorations, surveys, and research in the realms of geology, climatology, soil erosion, studies of plant life and its adaptation to soils, groundwaters, stream-flow control, forestry, genetics, development of techniques in evolving new products from low-grade material and little-used species, as the ground work upon which to build a more permanent urban and rural civilization. The agricultural scientist has before him a tremendous public task and responsibility, namely, the restoration of our primary natural resources which were so greatly depleted in the early days of heedless exploitation. As one writer recently remarked, the country is suffering from the tragedy of our planlessness in the use of our land.

We went through the continent like an invading army, tarrying just long enough to "skim the cream" and waste the rest. We have destroyed our forests; we have depleted much of the fertility of our soils, and allowed it to be washed away; we have despoiled the beautiful landscape of our country; we have polluted our rivers and streams and turned them from objects of utility into sources of menace to life and property. Today, in many parts of our country, and particularly in sections of the Lake States region, we find nothing but rural slums, where stable, economically independent communities once existed.

America must be rebuilt from the very foundation. The original productivity of the land must be restored, if it is to sustain a happy people permanently. Plans which contemplate the shifting of large portions of our people from regions which have become low in productivity to regions which perhaps because of more favorable climate and soils offer better opportunities will encounter serious opposition from the very people who are supposed to be benefited. I cannot envisage an America in which we have a few oases in the Southwest, Northwest, and South-

east, around which our total population is to be concentrated, while the rest of the country becomes depopulated, is neglected and permitted to drift toward an incipient waste or desert.

Our national resources must be restored region by region, each according to its natural heritage. We cannot say to the Lake States region, for instance, that inasmuch as timber can be grown more quickly and cheaply in the Southeast or Northwest, you should neglect your own forest resources and become economically dependent upon other parts of the country.

I can think of no nobler task confronting any group of scientists, and with the spirit of public service which permeates the research staff of your experiment station I do not doubt that its great knowledge and talents will be dedicated to this task. There is before your Experiment Station a life of usefulness, even more fruitful in the future than it has been in the past.

CONCLUDING LUNCHEON

Saturday Noon, June 15, 1935

Theme: Service to the State

Presiding: R. A. Gortner, Chief, Division of Agricultural Biochemistry, University Department of Agriculture

Addresses

1. Recognition of the Work of Dr. C. H. Eckles, A. A. Dowell, Superintendent, Northwest School and Experiment Station, Crookston.

2. Recognition of the Work of Dr. R. W. Thatcher, R. A. Gortner.

3. The University in the Service of the State, Guy Stanton Ford, Dean, Graduate School, University of Minnesota.

CLARENCE HENRY ECKLES[1]

April 14, 1875—February 13, 1933

A. A. Dowell, Superintendent, Northwest School and Experiment Station, and President, Red River Valley Dairymen's Association

Some men achieve greatness largely through their individual efforts. For example, many of the great painters, sculptors, musicians, and writers of the past stand out above their fellows because of the great masterpieces they have produced. Others have made their greatest contribution by inspiring those with whom they came in contact. Comparatively few men have distinguished themselves both directly through their individual efforts and indirectly through the work of others who have been inspired or guided by them. Dr. Clarence Henry Eckles belongs to this select group.

In reviewing the life and work of this great agriculturist, one is impressed with his modest unassuming manner, his fixity of purpose, his keen analytical mind, his almost prophetic vision, his friendly interest in those with whom he came in contact, and his unusual ability to fire his associates and assistants with an overpowering desire to add to the existing stock of knowledge.

Dr. Eckles was born on a farm near Marshalltown, Iowa, April 14, 1875. At the age of sixteen, he entered the Iowa State College, graduating four years later with the degree of Bachelor of Science. Those of us who have gone through the experience of the recent depression may have some idea of the mental if not physical environment under which he carried his undergraduate work in the early nineties. We can imagine that his associates entertained doubts as to the future of an industry that had experienced a steady decline in prices for more than two decades. Dr. Eckles' fixity of purpose so evident throughout his later life, no doubt, served him well at this early age. He immediately accepted an appointment as assistant in dairy husbandry and dairy bacteriology in the college from which he graduated. At a time when advanced degrees were by no means common, most young men would have been content to devote their energies to the tasks at hand. Not so with Dr. Eckles. Realizing that additional training would be invaluable in his chosen field, he entered the University of Wisconsin as

[1] Presentation of plaque in memory of Dr. Clarence Henry Eckles to the University of Minnesota during the semi-centennial celebration of the establishment of the Minnesota Agricultural Experiment Station at University Farm, St. Paul, June 15, 1935.

a graduate student in dairy bacteriology in 1896, but returned to the Iowa State College where the degree of Master of Science was conferred upon him the following year. From 1895 to 1901, except for the time spent in graduate work at the University of Wisconsin and for one term when he served as instructor of dairy manufacturing at the Massachusetts Agricultural College, he continued his work at the Iowa state College as dairy bacteriologist and had charge of the college dairy herd.

The quality of his work as a pioneer in this field led to his appointment as assistant professor in charge of the newly created department of dairy husbandry at the University of Missouri in 1901. Here he found a most fertile field for the development of teaching and research work. Most men would have been taxed to the limit of their capacities in organizing and developing a new department. This man, however, visioned a future that could be fashioned only by well-trained minds. Consequently, he set aside time to continue his scientific training by a year's study under Fleischmann at Georgia Augusta University at Göttingen, Germany, and under von Freudenreich at Berne, Switzerland, supplemented by a trip through the dairy centers of Denmark, Sweden, England, Holland, and the Island of Jersey. Upon returning from Europe, he entered upon his work at Missouri with renewed zeal. His research program was expanded, and bulletins, scientific articles, and contributions to farm journals were issued with increasing frequency. Students interested in graduate work in dairy husbandry came to Missouri in increasing numbers to take their training under Dr. Eckles. His fame as a teacher and scientist gained momentum with each passing year. By 1919 it was estimated that one-third of the departments of dairy husbandry in other states were directed by former students, while many important federal and state positions were occupied by students who had received instruction under him.

In 1919 Dr. Eckles was appointed chief of the Division of Dairy Husbandry of the University of Minnesota. His achievements at this institution are fresh in the minds of all who are here assembled to pay tribute to one who contributed much to the advance of agricultural science. An increasing number of graduate students from all parts of the world came to Minnesota to sit at the feet of the master. He gave them scholarly instruction based upon a scientific yet practical knowledge of problems confronting the industry. Above all, he added the human touch that emanates only from a teacher who is in love with his work and with those he is privileged to serve. Dr. Eckles' associates have stated that "a total of 142 students have had at least one year of post graduate work under his guidance. Of these, 89 obtained the

degree of Master of Arts or Master of Science, and eight, the degree of Doctor of Philosophy."

Dr. Eckles was a tireless worker and prolific writer. His first book, "Dairy Cattle and Milk Production," was published in 1912. This was followed in 1916 by "Dairy Farming" with G. F. Warren as co-author, and in 1929 by "Milk and Milk Products" under the joint authorship of C. H. Eckles, W. B. Combs, and H. Macy. He was the sole or joint author of about 110 station bulletins and research papers, in addition to a great many timely articles contributed to leading farm journals.

Honors were showered upon Dr. Eckles throughout the later years of his eventful career. In 1916 the honorary degree of Doctor of Science was conferred upon him by the Iowa State College. During the same year, a number of former students organized the "Eckles Club" in honor of their chief. A total of 146 former students are now listed as members of this organization. In 1928 he was selected as one of the "Ten Master Minds of Dairying" by a committee representing all branches of the industry. He was appointed official delegate of the United States government to the World's Dairy Congress at Copenhagen in 1931. He was one of the founders of the American Dairy Science Association and served as its president in 1921. He assisted in establishing the Journal of Dairy Science, serving as an associate editor from 1922 until his death. He served as dairy editor of numerous agricultural journals. He was a member of the Society of Experimental Biology and Medicine; Fellow of the Iowa Academy of Science; Fellow of the American Association for the Advancement of Science, and a member of Alpa Zeta, Gamma Sigma Delta, Phi Kappa Phi, and Sigma Xi.

This brief summary of the life and work of Dr. Eckles gives some idea of the important part he played in the history and development of dairying in America. He occupied a position not only of national but international prominence. We are told that at a banquet held during the World Dairy Congress at Copenhagen in 1931, the chairman introduced the representatives of the various countries by giving the name, town, state or province, and nation, together with the positions they occupied in their respective countries. When the chairman came to Dr. Eckles, he said, "Gentlemen, I have the honor to present Dr. C. H. Eckles." No other statement was required—his name was known throughout the world.

During his life we recognized his unusual ability as a teacher, scholar, counselor, and friend. His virile pen left many valuable records which not only added to our current stock of knowledge, but will stimulate our thinking for years to come. His greatest contribution, however, will

flow from the many graduate students who came to him from all parts of the world. This influence time only can appraise.

On behalf of the dairy interests of the Northwest, I am pleased to present to the University of Minnesota this bronze plaque bearing the likeness of Dr. Clarence Henry Eckles, together with the following inscription:

CLARENCE HENRY ECKLES
1875-1933

* * * * * *

CHIEF, DIVISION OF DAIRY HUSBANDRY,
UNIVERSITY OF MINNESOTA, 1919-1933

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PRE-EMINENT TEACHER, SCHOLAR, AUTHOR AND SCIENTIST IN THE FIELD OF DAIRYING
FRIENDLY COUNSELOR, BUILDER OF CHARACTER AND LEADERSHIP

ROSCOE WILFRED THATCHER

Ross Aiken Gortner, Chief, Division of Agricultural Biochemistry, University of Minnesota

Roscoe Wilfred Thatcher was born at Chatham Center, Ohio, October 5, 1872, and died at Amherst, Massachusetts, December 6, 1933. He was educated in the public schools and at the University of Nebraska, from which institution he received a B.S. degree in 1898 and a M.A. degree in 1901.

From 1899 to 1901 he served as assistant chemist in the Nebraska Agricultural Experiment Station, and this association with the problems of agriculture unquestionably so stimulated his scientific imagination as to be the determining factor for his future life-work; for from this date we find him devoting all of his energies to solving the problems which face American agriculture.

Thatcher left the Nebraska Agricultural Experiment Station in 1901 to associate himself with the similar institution in the State of Washington, where he was successively assistant chemist, chemist, and finally from 1907 to 1913 director of the Washington Agricultural Experiment Station. In 1909 Prof. Harry Snyder resigned the position which he had held for 18 years as chief of the Division of Agricultural Chemistry and Soils in the Minnesota Agricultural Experiment Station. During

these years Professor Snyder had greatly expanded the work in agricultural chemistry, which when he came was a "one man department," and had brought international recognition to the Minnesota Agricultural Experiment Station by his pioneer researches in nutrition, cereal chemistry, and soils.

In 1913 the Board of Regents recognized that both agricultural chemistry and soils were sufficiently large subject matter fields to justify separate administrative divisions, so the old Division of Agricultural Chemistry was reorganized into a Division of Soils under the direction of Dr. F. J. Alway, then at the Nebraska Agricultural Experiment Station, and Professor Thatcher was called from Washington to become chief of the newly organized Division of Agricultural Biochemistry.

Professor Thatcher entered upon his new duties with great enthusiasm. In his earlier studies he had become impressed with the important rôle that plants play in the biological cycle. He realized fully that nearly all forms of life upon the earth are, in the last analysis, dependent upon plants for existence, and that life as we know it upon the earth would largely disappear if the fundamental chemical reaction which we call photosynthesis should cease. He recognized that in the laboratories of the green leaves of the plant we have continually going on the greatest and most important of the chemical reactions known to man, and he came to Minnesota with the firm intention of building here at our experiment station a great center of plant science research. How well he succeeded is attested, at least in part, by the large number of graduate students that each year come to our laboratories for study and research.

Professor Thatcher's great forte lay in the field of organization and administration. His arrival at Minnesota was coincident with the establishment of the Graduate School as a separate administrative unit, and he assisted greatly in the development of this new unit and in putting graduate work in agriculture on a par with graduate work in the physical sciences and the humanities.

As I review my memories of many years association with Professor Thatcher, first as my colleague, later as my chief, and finally as my dean and director, two of his personal traits appear outstanding.

In the first place, he was intensely democratic. I remember one long conference that I had with him in which he insisted that he was going to resign as "chief" of the division and work for the establishment of a "chairmanship." In that conference I opposed him and insisted that, while democracy was the ideal arrangement, nevertheless I felt that some individual should have final authority, so that some one person would be finally responsible to the University authorities for the conduct

and development of the division and for providing for long-time planning so that the plans for the future could continue year after year without the possibility of serious interruption. I insisted that I wanted the right to propose plans or changes in plans, and perhaps at times to oppose him in matters of internal policy, but that in the end the "chief" should have the power of final approval or veto, and that all members of the department should understand that that was the case. Fortunately—I believe—I persuaded him not to ask for a change in his administrative title.

The other outstanding trait was his insistence on the necessity of cooperative effort in solving the major problems of agriculture. When Thatcher came to Minnesota he found a number of divisions, mostly working in water-tight compartments. Cooperative attack by several divisions on common problems was the rare exception. Thatcher at once began to attempt to tear down the walls which had been constructed between divisional activities, and when in 1917 he was made dean of the Department of Agriculture and director of the Experiment Station, he was in a position to demand that these artificial barriers should be removed and that many projects in the Experiment Station should be drawn so as to cross departmental lines and require cooperative effort. This, I believe, was his major contribution to our Experiment Station, and it was so successful that today we are one of those all too few institutions that the Federal Inspector annually compliments as having an outstanding cooperative spirit and program of research.

As dean and director, Thatcher builded for the future. He sought out leading scientists in various fields and induced them to join the staff of the Minnesota Agricultural Experiment Station. He was largely responsible for the establishment of our "Journal Series" of scientific publications. He encouraged fundamental research on long-time problems, as opposed to superficial attack on minor items. To him the problems of agriculture were inseparable from the major problems of the fundamental sciences of biology, chemistry, and physics, as they relate to life processes. Fortunately, he remained at Minnesota long enough to impress his ideals upon a goodly number of the staff, and his task of reorganization was largely accomplished when he left us in 1921 to become director of the New York Agricultural Experiment Station.

In 1927 he left Cornell to become president of Massachusetts Agricultural College, which position he held until poor health forced his resignation shortly before his death. He died "in the harness" at Massachusetts Agricultural College as research professor of plant chemistry.

During his lifetime he was the recipient of many honors and served on many important commissions, both state and national. He received honorary degrees of Doctor of Agriculture from the University of Nebraska, Doctor of Laws from Hobart College, and Doctor of Science from the Catholic University of Chili. We at Minnesota remember him as a friend, as a democratic colleague, and as an administrator whose chief aim was to advance the science and art of agriculture.

THE STATE IN THE SERVICE OF THE UNIVERSITY

Guy Stanton Ford, Dean, Graduate School, University of Minnesota

There is one grand, hoary, old subject for university speakers on occasions like this. It has served commencement orators and pleaders for larger appropriations as faithfully as the flag, the constitution, and the Declaration of Independence have served the serried battalions of Fourth of July orators. That subject is "The University in the Service of the State." It is so venerable that it seems almost a desecration to speak of it in tones as loud as this auditorium requires. One feels as though he had not shown due respect to age. I can, in imagination, trace the course of this antique phrase down through the ages. When it was first phrased I am not sure, but I feel sure that the rector of the University of Alexandria besought larger appropriations from Cleopatra on the grounds that Euclid on their faculty had put all Egyptian farmers in debt to scholarship by geometrical demonstrations that might be of unsuspected value in resurveying their farms flooded by the Nile. It might even help build a program that would astonish and enthrall Antony. And so on down through the ages. The state university where I took my bachelor's degree literally founded its greatness before my eyes on a scientific milk tester devised by one of its professors and ultimately of prime importance in building the wealth of a great dairy state.

Every state university has its list of scientific discoveries that it can count as a contribution to the material welfare of the people of its commonwealth. These are very real assets of increasing value and in the aggregate justify on a dollar for dollar basis the most generous support possible within the resources of the state. If they alone were considered, they would give precedence to the university in a distribution

of available income over the offices, public buildings, and similar perquisites dear to the heart of the local politician. They are the familiar and concrete evidences of the University in the service of the state. These services are so recurrent and manifold that they will serve acceptably as a theme to as many more generations of university speakers as they have served in the past.

If a subject as old as this still has the vigor of youth, it ought to be tough enough and limber enough to survive the unusual exercise of being stood on its head for a few minutes this evening. I should like to put it suddenly into reverse even if I strip the gears of our conventional thinking. My query is whether talking about the state in the service of the university won't lift the university and its relations to the commonwealth to a higher and better illuminated level, one more worthy of the two institutions which embody a people's faith in law and learning.

History may say that the University of Minnesota was established by the act of some dated legislature or convention. In form that is correct. In essence it is incorrect. This university is the embodiment of an idea older than this or any existing political institution. Next after food, shelter, family, and some form of worship, mankind has turned to the creation or support of those agencies and specially designated men who would preserve knowledge, extend it and transmit it to the next generation. Out of that persisting purpose whose first evidence may have been the wise man of a tribe or the bards who made the Homeric epic cycle possible came the schools and thinkers of Athens and the foundations of the medieval universities with which the history of the University of Minnesota, and of Harvard and Yale really begin. The academic garb we wear, the degrees we confer, many elements of our college organization, the very name of commencement are visible evidences that the beginnings of this university antedate by many centuries any act of the State of Minnesota. These historical survivals and the university itself are the evidence of the wisdom of Minnesota pioneers in recognizing an obligation to education as the most permanent creative force in developing and maintaining civilization.

The obligation to maintain education and cherish scholarship is made inescapable by the nature of the experiment in self-government to which this American republic is dedicated. One may deny the influence and heritage of all the history I have pressed into the preceding paragraph but he can not deny that education, and by that token universities, are the inescapable necessities of intelligent self-government and the only sure guarantees that political equality can be maintained. "The whole people," said John Adams in 1785, "must take upon themselves the education of the whole people, and must be willing to bear the expense

of it." Washington and Jefferson and Webster gave utterance to the same idea. The American nation as a whole, through the Morrill Act in 1862 bearing the signature of a man who treasured the opportunity for others to secure what he had never received, gave "the most magnificent endowment of higher education ever made in one law by any political body." When the nation thus put its wealth in the service of higher education no state could fail to sacrifice for the same great cause. German historians make much of the fact that the University of Berlin was founded in 1810 when the uncertain future of the Prussian state and monarchy was dependent on the humors of the conquering Napoleon. Is it not more significant that this democratic nation during one of its great political and economic crises chose to give to every state the possibilities of Federal support for higher education?

The pioneers of this state, when they founded this University a decade earlier, had set aside part of their limited resources to serve higher education. In every frontier commonwealth from the Alleghenies to the Pacific appears inevitably the medieval trilogy of state and church and university, each to serve in its own independent and peculiar way the establishment of a new civilization by these persisting and time hallowed agencies.

It is the pre-eminent place of the university in relation to the state that concerns us today. What is the university that it should lay claim to precedence, to loyalty, to freedom beyond that we yield to party, or prejudice or changing forms of political organization? *The state university is the state, the people of the state, thinking.* It is a body of scholars and students set aside by society to think and think hard not only about what is or has been but about what may be as each scholar sees it in his dedicated field of special competence.

In these days of clamor and confusion, of demagogic prophets crying over the radio and through newspaper syndicates, lo here, lo there, I should like to state more boldly and more challengingly the place and purpose of the university now and throughout the ages. It is the business of the university, of the scholars who are the university, to think differently from the masses of mankind. That is the high adventure to which they are dedicated. It is the supreme purpose for which this university and all universities were founded and for which they were supported. If the scholar with all his study and special competence dare not follow where the logic of his facts lead even tho he traverse the intrenched power of selfish individuals, and economic and political groups, he can not honestly claim the wage that society pays him. The tragedy of the German universities that once led the world is not that they have become the educational eunuchs at the portals of a new

Byzantinism but that they went down without a protest, without fighting martyrs to defend the freedom they will scarcely deserve if and when another generation restores it to them. The sovereign who deserted his people and his army will never return and his descendents, if they are restored, will wear a tarnished and uneasy crown. The university professor who fearfully accepts dictatorship by a man or a mob may well ponder the fate of William II and the Hohenzollerens.

The elevated and peculiar position assigned to the university would be weakened and obscured if you mistake the vigor with which I have stated it for belligerency. That is far from my thought. It will equally disappear from yours if we recall the place in social progress and the value of the man who makes it his mission to think differently from his fellow men and seeks by new truth or new applications of old truths to alter their ways of thinking and acting. It is the otherwise thinking man who has at every level of civilization put mankind upon the upward path to higher levels of social, economic, and spiritual well-being. Without some man or men, unknown and undiscoverable through the mists of time, the stone age would never have produced the bronze and iron ages, the crooked stick would still plow the fields of Mesopotamia and Minnesota, the rule of tooth and fang would be the only law, and the fears of nature and nature's gods the only faith. Somebody thought otherwise and there was a new heaven and a new earth.

Step by step mankind has been pricked on by the probing minds of consecrated dissenters to scale new heights in culture and human welfare. It is true enough that the pathway has been lighted too often by the fagot fires of martyrs but by their gleam the heavy world has stumbled on into the "broad realmed future" staked out for it "by him who dared himself to trust." Gradually through the centuries there has been built up not only a frail but persisting tolerance of the otherwise thinking man and in the more advanced and civilized states an encouragement of him in the corporate institution of universities, private and public. It is in the universities, not exclusively, but predominantly, that society finds and supports that "non-acquisitive leadership indispensable to the endurance of society"—certainly of a democratic society. The people know this instinctively and beneath all the passion and prejudice sometimes aroused to becloud their judgment for a moment, they have never abandoned their faith that in their state university there is one group that is thinking and acting in terms of the general welfare, conceived in its highest and most permanent forms.

Where else could they repose such faith? In what other hands could they lodge such a supreme responsibility for their own and their children's welfare? Certainly not in the change and shift and haste and

compromise of any or all of the disparate and clashing political agencies that occupy the foreground of American public discussion. In the squirrel cage of political activity there has been in the past too little evidence, too little occasion and less opportunity for the kind of foresighted thought and action that eases social strains before they threaten the whole structure. That is not perhaps the true function of the politician who becomes a statesman on the rare occasions when he puts his feet instead of his ear to the ground. What we expect of legislation is that it register the changes in social attitudes or make easier that change when it is hampered by outworn political machinery. The exploration of new ground to be occupied, the finding of paths, the testing of the merits of conflicting claims is best done by those indifferent to party and dogma and group or individual advantage. Such commissions are best executed by those who devote their lives to such tasks in universities like this. It is here that men never forget that tomorrow will follow today. It is here that the tomorrow of Minnesota walks the campus embodied in thousands of students.

It is not the primary responsibility of the scholar to enter the arena to engage in the necessary political discussion that follows. He is still a citizen, of course, but as a searcher for the truth he properly goes on to new tasks rather than let himself be drawn into the arena. His best service is as the people's expert adviser rather than as a partisan advocate. The scholar and the university can and do insist that the partisan of whatever stripe shall not block them in the execution of the task they have been performing since the foundation of universities and will be performing long after any selfish seeker for power has sunk out of sight and sound. No man seeking political preferment has ever built a public career by attacking the schools or attempting to set up his own ignorance and prejudice as the limits for learning in a state university. That tested fact does more than point a moral for the wary in public life; it is a profound tribute to American democracy and an assurance that it instinctively preserves what is most necessary for its own preservation.

While the people and their representatives on the governing boards acknowledge freely their debt to the university as a whole, they are not always quite clear that these values sink to zero when the outstanding scholars go elsewhere because of more favorable conditions. The great creative mind in any field of scholarship is so rare that when once found the great service of presidents and deans and curators and legislators is to make his work possible. The value to a state of a great scientist or scholar in any field can not be measured in dollars and cents. Some one once asked how much England could afford to give if she

could find another Tyndall or Huxley or Darwin. Would it be a hundred thousand pounds—a half million dollars for the one man in his generation, perhaps in his century? What state or nation would not give it willingly and could well afford it.

Each university has among its staff men whose scientific labors have meant the founding or the rehabilitation of industries vital to the state's economic welfare. Or of men whose studies of the social and political processes have pointed out the possibilities of governmental economies and a more efficient government. Too often we are blind to the value of such men. Minnesota has had and lost just such irreplaceable men. Each university could make up its roll of distinguished scholars who would more than justify any claim that I may have made for the state enrolling to the limit of its resources in the service of the university. There can of course be no state embargo on the export of professors, but a commonwealth of the people should be wise enough and wealthy enough at least to compete with industry or private endowment for the service of the best brains. Upon such service given by those who seek no power or material advantages for themselves depends, I repeat, the perpetuity of a democratic society based upon an everchanging equilibrium of contending acquisitive interests.

In conclusion I want to admit freely that it is a great distinction for this University of Minnesota to be known for its service to the state. But it is an equally great distinction for the State of Minnesota, for its citizens, for the alumni of this institution to be known for what they do in the service of the University. Here, and in centers such as this, there is the embodiment in a university of one of the undying interests of the human spirit in its quest for truth and the good life.

We do not know what men, through what institutions, will govern us in the future, but we do know that so long as organized society exists in this commonwealth this university will be its beacon and a bulwark and that to them who serve it, whether as students or staff, as benefactors or intelligent citizens, it will impart something of its rich life and ageless youth.